Micro Enterprise Development Programme - MEDEP
GON/MOICS/UNDP – NEP/08/006

Resource Analysis of Chyuri (*Aesandra butyracea*) in Nepal

Micro-Enterprise Development Programme
(MEDEP-NEP 08/006)
Kathmandu, Nepal

June 2010

Micro-Enterprise Development Programme (MEDEP-NEP 08/006)
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Note on the use of the terms:
Aesandra butyracea is known by various names; Indian butter tree, Nepal butter tree, butter tree. In Nepali some say ‘Chyuri’ and others say ‘Chiuri’.

ACKNOWLEDGMENTS

This study was carried out within the overall framework of the Micro-Enterprise Development Programme (MEDEP-NEP 08/006) with an objective to identify the geographical and ecological coverage of Chyuri tree, and to estimate the resource potentiality for establishment of enterprises. First of all, I would like to express my sincere thanks to MEDEP for offering this exciting assignment to me. My special thanks go to Dr. Lakshman Pun, National Programme Manager and Dr. Raj Bahadur Shrestha for providing professional inputs and administrative support to accomplish this study. I offer my sincere thanks to the entire team of NPSO/MEDEP for extending their support and cooperation in carrying out this study. I also wish to thank the APSO family of Dhangadi, Surkhet, Dang, Udayapur and Baglung, who have carried out field studies and provided valuable information on geographical and ecological coverage of Chyuri trees in their respective districts.

I am grateful to various stakeholders who made available their time for meetings and provided a wealth of information on various aspects of Chyuri products. I especially thank Mr. Madhav Prasad Acharya, Director General of Department of Forest for recommending District Forest Officers to provide available information to MEDEP. I am also thankful to Livelihood and Forestry Programme (LFP), Federation of Nepal Beekeepers (FNBK), DFOs (Arghakhanchi, Bajura, Dang and Nawalparasi), Chyuri processors and traders.

Finally, I would like to thank Mr. Sanjeeb Pokhrel for carrying out field survey and recording GPS data of Chyuri threshold areas, and Mr. Janak Raj Joshi for developing GIS maps and supporting me in various ways to promulgate this study.

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1. BACKGROUND

Millions of people worldwide depend on the harvest of non-timber forest products (NTFP) for their livelihoods (Vedeld et al. 2004). Over the last two decades, the importance of NTFPs is globally recognized as a key component of health care and biodiversity conservation as well. There is a growing demand of NTFPs in pharmaceutical and botanical medicines, food and flavoring items, cleaning products, insecticides and other industries. The complex relationships between NTFP harvest and conservation is becoming a major concerns for many development organizations, research institutions and individuals (Ticktin 2004, Kusters et al. 2006). This comes as a result of various factors, including concern about overexploitation and interest in the promotion of NTFP harvest as a conservation and development strategy (SCBD, 2001). The various reports revealed that the harvest strategies are influenced by the socioeconomic, political, and ecological contexts of the country and are highly variable across communities (Ghirmire et al. 2005; Kusters et al. 2006).

The diverse geographic and climatic variations of Nepal presents a favourable environment for the production of NTFPs such as medicinal and aromatic plants, wild fruits and vegetables, dying and colouring substances, etc, which have high value chain enhancement opportunities. These products significantly contribute to national income and employment, especially for the poor and marginalized communities who live in and around forests.

However, Nepal has not been able to adequately utilize them. There is general lack of sustainable production practices, inappropriate harvesting and post-harvest practices, inappropriate value addition, poorly organized marketing information system, and lack of standardized production system, which hindered international recognition of Nepali NTFPs and posed challenges to maximize equitable economic returns (Poudel, undated).

Various reports and research indicate that the NTFPs sector in Nepal is expected to grow fast in the coming years and it will continue to play a vital role in the national economy. But, if serious efforts are not undertaken, this will lead to the erosion and degradation of NTFP resources and un-sustained availability of quality raw materials. In order to cater to increasing levels of commercials demands of NTFPs by a broad range of people, more careful assessment of NTFP resource base as well as intensive management and sustainable harvesting of NTFPs have become mandatory.

Realizing the cognizance of resource sustainability, the Government of Nepal (GoN) is emphasizing the need to assure sustainable harvesting in wild and commercial domestication (i.e. *ex situ* cultivation) of important plant resources. Many development agencies have been supporting this government initiative by providing grants, loans and technical assistance. As a result of these efforts and with the increased access to information and technology, the areas under cultivation vis-à-vis production of several forest resources, like *Asparagus, Amla, Gheukumari* have rapidly grown over the last few years, however the actual status of distribution and economic potential of such plants in the wild has not been properly documented.

> The opportunity of "**Green Employment"** will be created in rural area through implementing forest entrepreneurship program based on community owned forest resources with special priority. The area of community forest and leasehold forest will be expanded. Forests will be commercialized by imparting technology to prepare Briquette and timber through branches and forest wastage to community forest user groups. For this propose, revolving fund up to Rs. 100 million will be created by the Government. Under this program, communities will establish **industries based on forest raw materials**, i e. herb, ***Chyuri Ghee***, *Lokta*, Cane Bamboo, Bee farming, Field broom, *Membin* etc.
>
> Extracted from Budget Speech of Finance Minister for the year 2009/10

Aesandra butyracea is one of various tree species commercially harvested for its butter throughout the low hills areas of Nepal. It is a multipurpose plant, popularly considered as "*Kalpbrikscha of Kaliyuga*" since all parts of the plants are used for variety of purposes. Despite its very high socio-economic importance to local communities, very little information is available on the geographical and ecological coverage of the trees and status of resource availability. Therefore, the present study is conducted under the initiative of Micro-Enterprise Development Programme (MEDEP) of UNDP/GoN, which has been promoting local resource based micro-enterprises to create off-farm employment and income opportunities for the rural communities.

2. OBJECTIVES

This study on Resource Analysis of Chyuri (*Aesandra butyracea*) in Nepal was carried out within the overall framework of the Micro-Enterprise Development Programme, which is a joint initiative of the Government of Nepal and United Nations Development Programme. The main aim of the study was to assess the major production areas and production quantities of the Chyuri fruits that will be useful for the promotion of local resource based enterprises. The specific objectives of the study are:

- To identify the geographical and ecological coverage of the resources with reference to the district and VDC;
- To estimate the number of Chyuri trees;
- To identify local use of these resources with reference to quantity and place, and product items and markets.

3. MATERIALS AND METHODS

The study was carried out based on Multiple Research Methodology (MRM), which included review of secondary information, key informant survey, field observation and sample survey techniques. The secondary information was collected from published documents, internet data and reports. Informal interactions and semi-structured interviews were held with various professionals and enterprises involved in making use of Chyuri products. A standard set of questionnaire and checklists were prepared for different groups of stakeholders to document information relating to trends in production, local perceptions of resource availability, market condition, local uses, etc.

3.1 Data and Materials

To carry out this study, the following data/information are used

- Information on availability of Chyuri trees in certain district and VDCs (collected from the District Forest Office, MEDEP personnel, and local people through telephone, e-mails, fax and postal mails)
- Existing reports and research publications on availability and analysis of Chyuri in Nepal and neighbouring countries
- Land cover of whole Nepal, a GIS (shape file) layer
- Digital Elevation Model (DEM) of whole Nepal, ninety meter resolution (raster grid format)
- Administrative area of whole Nepal (with VDC), a GIS (shape file) layer

- Information on location of Chyuri plants in some sample pocket area, captured by Global Positioning System (GPS)
- Data regarding roads and rivers, a GIS (shape file) layer

3.2 Methodology

This study of mapping Chyuri potential areas and quantifying the Chyuri product consist of the following main steps

3.2.1 Assumptions

Different available literatures and research reports show that Chyuri can be found within a range of elevation of 1000 m to 2500 m from MSL. Similarly availability of Chyuri is observed in Natural and/or community forests. Based on these facts and some other information collected from different sources, we used the following three assumptions for identifying spatial distribution of Chyuri potential areas:

- The area should fall on the administrative area (District/VDC), which has been already identified as Chyuri potential area
- The area should fall on forest/vegetation area
- The area should fall within an area of minimum elevation 1000 m to maximum elevation of 2500 m from mean see level

3.2.2 Data preparation

GIS is used to analyse the data and present the result in the form of map. The necessary input data required for this purpose were prepared. In this process, the information provided by different persons/institution from different district on availability of Chyuri in different VDC was entered in GIS.

Based on the three assumptions made in above section, mainly three GIS layers were used: the Administrative area with VDC having information on Chyuri potential area, The DEM and the Landcover (Forest cover). These different GIS layers available from different sources were converted in same projection system and made ready for overlay and further analysis.

3.2.3 Data analysis

GIS layers are classified as follows:

- The administrative layer is classified as Chyuri and non-Chyuri area.
- Landcover is classified as Forest cover and non-Forest cover area.
- DEM is classified as the area within 1000 m – 2500 m and other area.
- By using GIS overlay operation of administrative layer with Chyuri area, Forest cover and DEM layer within the elevation of 1000 m – 2500 m, the Chyuri potential area were extracted.
- Report and information from local people shows that , out of these Chyuri potential area, only about 33% of the area is found covered with Chyuri (Dang, Pyuthan).Therefore, the 33% of total Chyuri potential area is estimated as Chyuri covered area.

3.2.4 Visualization

The Chyuri potential area, thus identified, is visualized in GIS map with proper symbolization.

3.2.5 Quantifying Chyuri Trees

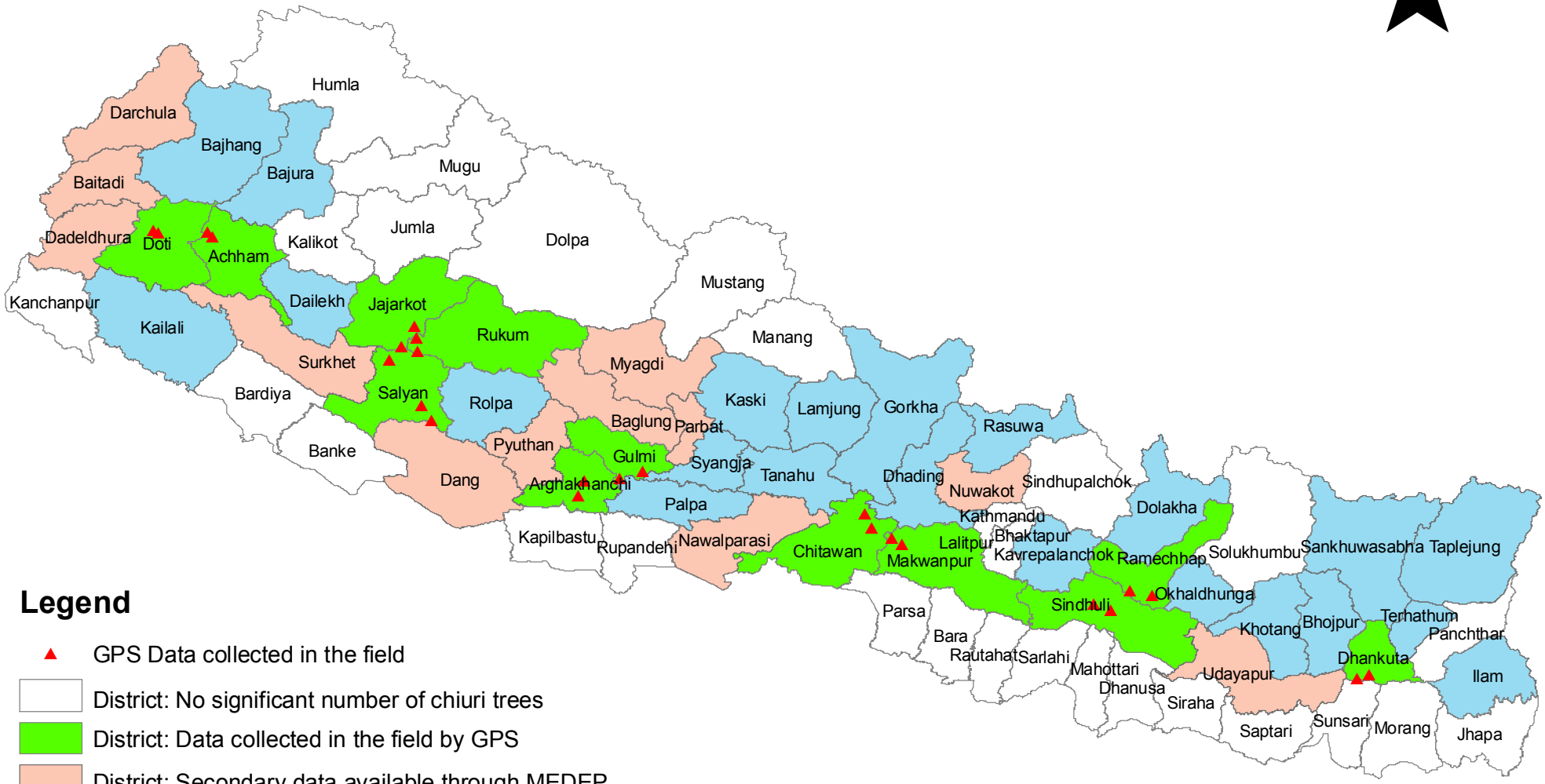
The method used for quantifying Chyuri trees is as follows:

- Certain pockets are identified in Chyuri potential area in different Districts/VDCs
- A quadrant of certain area (50m*50m) is chosen in regular interval of distance
- The total numbers (n) of Chyuri plants per quadrant are counted
- The numbers of Chyuri plant per square kilometre are calculated from above observation as N= (n*1000000)/2500
- This number N of Chyuri plant per square kilometre is statistically averaged over the taken samples in administrative area (District/VDC)
- The total no. of Chyuri trees over an administrative area are calculated by N*A, where A is the total Chyuri covered area
- Number of Chyuri tree, thus estimated, are also visualized per administrative area (District) in the GIS map
- The GPS locations of the collected samples are also visualized in GIS map

Fixing quadrants for Enumeration of Chyuri Trees

Study of Chiuri Potential in Nepal

(Status of Data Collection)



4. GENERAL OVERVIEW OF THE BUTTER TREE

4.1. Description of the plant

Aesandra butyracea is a medium- to large-sized, deciduous multipurpose tree, naturally occurring in subtropical and warm temperate areas throughout the Himalaya; from Kumaon hills in the state of Uttarakhand in India through Nepal to Sikkim, Darjeeling, Bhutan and Arunachal Pradesh in the eastern Himalaya. The plant is commonly known as butter tree throughout the Himalaya. It is locally known as '*Chyuri*' in Nepal. In Hindi it is called '*Madhuca*', and in Sanskrit '*Madhupushpa*', which translates into English as 'honey flower'. In Dzonkhag -the official language of Bhutan, it is known as *'Yika Shing'*. In Nepal, there are several vernacular names used by different ethnic communities, such as Yoshi (Chepang), Chyumli (Tamang), Isi (Rai), Imseva (Limbu), Chihuli (Tharu), Ibuchi Pu Ma (Newar) for Chyuri (Manandhar and Manandhar, 2002).

Amongst NTFPs in Nepal, Chyuri belongs to the important trees that are utilized for an array of purposes by the rural households. It is well known for its butter (commonly known as Chyuri Gheu/Ghee or Phulwara butter), which has traditionally been used for daily cooking, and also for lighting lamps. The juicy pulp of ripe fruit is eaten fresh. The oilcakes are used as manure with pesticidal properties, as fish poison and as feed for animals after detoxification. They also produce good fuel wood, hard and durable timber, and the leaves are used as tree fodder in many areas in Nepal. In addition, Chyuri has a very important cultural value in Nepal, especially in Chepang community where the people give Chyuri plants as dowries to daughters indicating its significance in the livelihood of the Chepang community (Bhattrai et al, --).

Chyuri tree is considered to be a good soil binder and could be of immense value for promoting soil conservation. The tree provides habitat and food for a large number of animals and insects. Children, monkeys and langur shake the flowers and collect nectar for drinking. A large number of honeybees, wasps, hornets and other insects are found collecting nectar.

Due to its value as multipurpose tree, people in Chyuri threshold areas of Nepal generally do not chop up or fell the chyuri trees. They apply their own traditional way of tree management. There are a couple of development organizations supporting for the conservation and management of Chyuri plants. Yet, there is still a very little information available on its ecology and biology. Likewise, there is little published information about cultivation, tending and management of chyuri in agro-forestry systems or as a plantation fruit tree. Moreover, the resource availability in terms of quantity of butter, population size and trend of chyuri trees has not been precisely documented.

4.2. Physiological Characteristics

Taxonomically, Chyuri belongs to the plant family Sapotaceae (Box 1). The botanical characteristics of this species are well described by Boxburgh (1809), which could be perhaps the first documented information on morpho-physiology of Chyuri plant (Annex 1).

Chyuri tree grows up to a height of about 20 m, in hill slopes between 300 and 2000 m above sea level. The tree is usually found scattered in wastelands, pastures and cultivated fields near the villages. The tree also occurs singly or in small groups as a natural component of broadleaved forests, especially in association with simul (*Bombax ceiba)*, koiralo (*Bauhinia variegate)*, amla (*Embelica officinalis)*, sal (*Shorea robusta*), buddhairo (*Lagerstroemia parviflora*), dhayo (*Woodfordia fruticosa*), tatari (*Dillenia pentagyna*), barro (*Terminalia bellirica*), padke (*Carpesium nepalensis*), tanki (*Bauhinia purpurea*), saj (*Terminalia alata*), Bhalayo (*Rhus succedanea)* etc. Chyuri has a long flowering period beginning in September and lasting to February. There seems to be two different varieties of Chyuri plant; (i) early flowering variety grown in western region, and (ii) late flowering variety grown

Box 1: Taxonomy of the Butter Tree

Kingdom:	**Plantae** (Green Plants)
Subkingdom:	**Tracheobionta** (Vascular plants)
Superdivision:	**Spermatophyta** (Seed plants)
Division:	**Magnoliophyta** (Flowering plants)
Class:	**Magnoliopsida** (Dicotyledons)
Subclass:	**Dilleniidae**
Order:	**Ebenales**
Family:	**Sapotaceae** (Sapodilla family)
Genus:	***Aesandra***

Species: ***Aesandra butyracea (Roxb.) Baehni*** *[Boissiera 11:29. 1965]*
(= Bassia butyracea Roxb.) (= Diploknema butyracea (Roxb.) H. J. Lam)
(= Madhuca butyracea (Roxb.) J. F. Macbr.) (= Illipe butyracea (Roxb.) Engl.)

Chyuri Tree Grown in its Natural Habitat in Rolpa

towards east. Due to differences in flowering time, beekeepers of Chitwan district first bring their bee colonies to Dang valley, and then they bring back their colonies and place in Lothar, Silinge and Shaktikhor area of Makwanpur and Chitwan districts for production of Chyuri honey.

Bark dark grey or brownish and slightly fissured. The timber is white, soft, and porous; and is nearly as light as the *simul*, or cotton tree (*Bombax ceiba*).

Leaves alternate, petioled, obovate-cuneate, obtuse-pointed, entire; veins simple; and parallel; length, six to twelve inches; breadth, three to six. Petioles are from one to two inches long. Stipules, if any, are minute, and caduceus.

Flowers are creamy white, long stalked, usually crowded in fascicles on the leafy axis and have a soft, sweet aroma. The number of flowers per fascicle varies from 50 to 72. Each flower is 2.64 cm in diameter, and has 10-15 petals and 36-45 stamens. Calyx, four, five, or six leaved (five is by far the most common number); ovate, obtuse, covered externally with ferruginous pubescence, permanent. Corolla is tubular, subcylindric, spreading, oblong, obtuse divisions, longer than the tube. Stamens; filaments are as long as the tube of the Corolla, and inserted on its mouth. Anthers are linear-oblong. Pistil, germ conical, (ten or twelve celled, one seeded,) downy, surrounded with a downy nectarial ring. Style is longer than the stamens and stigma acute. A full grown tree can produce up to 90 kg of flowers in a year (Encyclopedia India). The gathering of the flowers nectar for making 'gur' is an important business for rural people.

Chyuri Flowers Crowded in a Fascicle

Chyuri Fruits

Fruits are light green when young and become yellowish or orange in colour when fully ripe, scented and sweet to taste. Berry oblong, generally pointed by a remaining portion of the style; smooth, fleshy, containing one, two, or three large seeds. The average fruit yield was estimated to be 5–155 kg/tree in different girth class sizes (Sundriyal and Sundriyal, 2003). Pulp of the fruit is sweet and juicy, but cannot be stored for a longer time due to low keeping quality.

Seeds oblong, rather round than flat, but differing in shape according to the number contained in each fruit; smooth, shining, light brown, lanceolate, lighter coloured, less smooth, umbilical mark on the inside. On opening the shell of the seed or nut, the kernel appears of the size and shape of a blanched

almond. Its seed kernel contains saponins. According to literature, the yield of oil is 42-47% of the weight of seeds. The viability of seed is very low which adversely effects its regeneration.

Pollen grains medium-sized (36.6 ± 9µ in diameter) round, mostly tetracolporate; some are tricolporate with granular exine sculpture.

4.3. Pest and Disease

In Nepal, study on pest and disease has not been undertaken yet. Hence, neither the presence of fungal or viral pathogen of Chyuri nor pests have been reported. However, in other parts of the Himalayas, a variety of biotic and abiotic damaging agents have been recorded on dying and dead Chyuri trees. Among the pests, bark beetle species, tentatively identified as a *Scolytomimus sp.* and a lepidopterous shoot borer were suspected as harmful insects that cause mortality of chyuri trees (Tshering, 2007). The impact survey carried out in Bhutan revealed a tremendous decline and mass mortality of Chyuri trees. According to the report, only one-fourth of the total tree surveyed in study area looked apparently healthy in Bhutan.

4.4. Socio-economic importance

Chyuri is amongst the most important trees that are utilized for an array of purposes by the rural households. The plant is well known for the butter or oil, which has traditionally been used for daily cooking, and also for lighting lamps. The oilcakes are used as manure with pesticidal properties, as fish poison and as feed for animals after detoxification. Chyuri flowers are extensively visited by honeybees and hence beekeeping is very popular in areas where Chyuri trees are abundant.

In addition, Chyuri has a very important cultural value in Nepal, especially in Chepang community where the people give Chyuri plants as dowries to daughters indicating its significance in the livelihood of the Chepang community (Bhattarai et al, --; Practical Action, 2008). The plant is also important from the ecological point of view. Chyuri tree is considered to be a good soil binder and could be of immense value for promoting soil conservation. The tree provides habitat and food for a large number of animals and insects. One can see a large number of monkeys shaking flowers to collect nectar for drinking and ants, honeybees, wasps, hornets and other insects collecting nectar from flowers.

Chyuri products and byproducts considerably contribute to the livelihood of people. A large number of people in the hills earn substantial amount of cash from the sale of Chyuri butter, honey and other value added products.

Chyuri honey and Sweets: Flowers are extensively visited by honeybees, as it produces enormous quantity of nectar (from 13.8 to 51.9 µl per day). Sugar concentration in this nectar is recorded at up to 42%. As a rich source of nectar, coupled with a long blooming period, Chyuri tree has a major role in honey production. In the

Box 2: Carbohydrate composition of Nectar, Honey & Gur

Parameters	Nectar	Honey	Gur
Fructose	9.57	36.27	4.09
Glucose	10.2	41.24	3.76
Sucrose	0.28	7.16	83.41
Dikojibiose	0.37	0.37	0.24
Maltose	0.25	0.97	0.09
Fructose/Glucose	0.98	0.88	1.09
Total Sugars	20.56	86.01	91.59

Source: Joshi & Pechhacker, 2002

low hill areas of Nepal, beekeepers can get 2-3 harvest of monofloral honey from Chyuri flowers. It is one of the very few plants in the world from which nectar can be collected without aid of honeybees for making juice, jam or gur. Small children also sip the sweet nectar from a flower. People in the western part of the country shake the flowers to collect nectar. This nectar after prolonged steaming is made into sugar candy, locally called 'gur'. The use of flowers nectar for making sweets is also a common practice in many states of India. There is a saying in Orissa "Aalai illa oorukku illuppai poo sarkarai", which reads in English as "in a village without a sugar mill, the flower of Indian butter tree is the sugar" (EncyclopedicaIndica). The sugar candy made out of Chyuri nectar is very rich in pollen. The total numbers of pollen grains per gram of candy were counted at 83,500 (Joshi and Pechhacker, 200). It is highly prized for its nutritive value and is also used to cure several diseases including stomach disorder, and fever (Awasthi, 1994).

Chyuri Honey Being Sold by Chepang Cooperative

Wine and Fruit Juices: Chyuri fruits are generally eaten as raw. They are tasty and refreshing. But since fruit ripens all at the same time, people cannot manage to consume them all. And it is difficult to bring the fruits to the market due to fairly low keeping quality. Therefore, it would return lots of profits to the communities if fruits are utilized in making juice, squash and jams. The flowers nectar and the pulp of the ripened fruits can also be used to make wine (Box 3). In some parts of Nepal and India, people have already been using the pulp to make rakshi (locally brewed alcohol). The juice is extracted by squeezing the fruits after removing the seeds. Then it is boiled, roasted wheat or millet flour is added and stirred to paste. The paste is poured into small forms and after cooling the hard, chocolate-like sweet can be eaten. The residues after juice extraction contain many saponins and are used for washing clothes and also as insecticides.

Box 3: The Wine of Chyuri (Mahuwa) Flowers

One day, Shiva the god thought about us, human beings. He wondered how we would offer wine to the gods and goddesses, after having made sacrifices of goats and chickens to them. Without Chyuri trees, how would the ceremony of offering wine be performed? He called over the parrot, the tiger and the boar, and said to them, Become Chyuri trees. Very well, we shall become Chyuri trees, the three said.

In the month of Chait (around March), flowers blossomed in the Chyuri trees. Flocks of tiny birds came to the trees. They pecked at the flowers and ate them. After eating no more than two or three flowers, they began calling out loudly, Cheep chirp cheep, cheep chirp cheep cheep. They raised a din. People thought, there definitely is some intoxicant in these flowers, or else the birds wouldn't make this noise after eating them. The people now began making wine from the same flowers, and began using the brew at all festivals and ceremonies. If a man drinks a tiny quantity of Chyuri wine, he becomes like a parrot and says the same thing over and over again. If he drinks a little more, he becomes like a tiger. He doesn't speak, he roars. And if he drinks still more, he becomes a boar. He lolls on the ground.

-Quoted from Encyclopaediaindica India

Butter or oil: The ripened seed kernels of Chyuri tree yield fat which is used as a substitute for butter/ghee and oil. According to the Practical Action, about 18 kg fruits are required to produce one litre of Chyuri ghee. The fruits are collected and squeezed to liberate the seeds. After cleaning and drying, the seeds are pounded using a traditional pounder, a *"Dhiki*", into a fine powder. The powder is steamed on a perforated plate over the boiling pan. The oil is then extracted using a traditional oil expeller called a "*Chepuwa*". The product is bitter in taste due to high content of impurities such as saponins which are carried along with extracted oil. The ghee needs post filtration or purification to make it edible. The final product is white with a strong smell and taste. The oil content of the seed is about 50-70% (Practical Action). Chyuri butter is rich in sugars and other nutrient, and used in daily cooking (Sundriyal and Sundriyal, 2003). It has consistency of ghee with white colour, pleasant taste and odour. Being rich in sugars and other nutrients, the butter is edible (Box 4). It is also convenient source of natural oleodipalmitin (62%) and is used in soaps, candles, and as medicine to treat gout and rheumatic conditions. The butter is also used for religious purposes such as structuring religious figures or offering butter lamps. The butter contains palmitic acid which soothes itches, chapped lips, hands and feet, particularly during winter. The palmitic acid content (56.6%) is the highest yet observed among seed fats (Khanka et al, 2009). The oil is also used as a base for face cream, and as an ointment to ease rheumatism, paralysis, sprains and contusions. It is also used to make value added products like, soap, candles, chocolates. Butter is a valuable preservative for mustard and sweet scented oils.

Box 4: Composition of Chyuri butter (Value in %)

Ash	3.2
Protein	3.81
Fat	1.57
Carbohydrate	81.63
Total Sugar	8.21
P	0.09
Na	0.065
K	0.816
Ca	0.817
Fe	0.178

Source: Sundriyal and Sundriyal, 2003

Oilcake: After extracting the oil from the seed, the remaining cake is used as fertiliser. The oilcake also has pesticidal properties and used as fish intoxicant and as insecticides in chilly plantations to control cutworms, *Agrotis ipsilon* (Lepidotpera, Noctuidae) (Tshering, 2007). The cake is also used as a wormicide, nematicide, molluscicide, rodenticide and insecticide. It can be used as feed in poultry farming after detoxification. It contains saponins, hence it can be used as detergent and can serve as a base for industry in future (Practical Action).

Table 1: Some commonly cited uses of Chyuri products[1]

Plant parts	Uses
Bark	• Bark of the tree is used in the treatment of rheumatism, ulcers, itching, and hemorrhage, inflammation of the tonsils, leprosy and diabetes. • The bark contains 17% tannin and is used in tanning, dyeing and as a fish poison.
Wood	• People generally do not fell the trees for timber. If the trees are felt down then the wood is used for making handles of tools, furniture, sheds for animals and constructing fences. • The small branches are used as fire wood.
Leaves	• Chyuri leaves are valuable as fodder for cattle and other domesticated animals, especially when other fodder sources are rare during February to April. • Leaves are also used as food plates and cups.

Flowers	• Flowers are extensively visited by honeybees for collection of nectar, • It is one of the rare plants in the world from which nectar can be collected without aid of honeybees for making juice, jam or gur
Fruits	• The fruits are eaten raw, while working in the field or forest. • The fatty juice from the fruit is used for making sweets or brewed for making alcohol (*Rakshi*). • The residues after juice extraction contain many saponins and are used for washing clothes and also as insecticides.
Oil or butter	• The oil and butter is used in daily cooking • The butter is used for religious purposes such as structuring religious figures or offering butter lamps. • The oil and butter is used to make value added products like, soap, candles, chocolates • Oil is used as an external ointment to ease rheumatism, paralysis and sprains. • Butter is a valuable preservative for mustard and sweet scented oils.
Oilcake	• The oilcakes are used as manure with pesticidal properties, as fish poison and as feed for animals after detoxification. • The oilcake contains saponins and act as detergent. • Also used as insecticides in chilly plantations to control cutworms, *Agrotis ipsilon* (Lepidotpera, Noctuidae).

[1]Cited from Khanka, 2009; Tshering, 2007, Joshi & Pechhacker, 2001; Practical Action and MEDEP Reports

5. GEOGRAPHICAL AND ECOLOGICAL COVERAGE

Geographical distribution of Chyuri extends from Darchula, Baitadi and Dadeldhura districts in the west to Dhankuta and Ilam district in the east. Out of the 75 districts of Nepal, almost 50 districts are known to have Chyuri plants. Of these districts, Baitadi, Dadeldhura, Doti, Surkhet, Jajarkot, Rolpa, Rukum, Pyuthan, Dang, Arghakachi, Makwanpur, Dhading and Gorkha contained large number of chyuri trees (See Figure 2).

Chyuri is microclimate specific plant, found in patches in between Churia and Mahabharat range. There is high variation both within and across the districts, especially in terms of number of trees, production of fruits and quality of butter extracted. Generally speaking, the eastern part of the country has a fewer number of trees than the western part. This may be due to prevalence of more humid climatic conditions. The plant occurs singly or in small groups as a natural component of broadleaved forests as well as on agricultural land.

In recent years some people have also started the plantation of the trees in their private land and community forestry area. Yet, it is not very attractive to small farmers for plantation in farm land, since it is slow growing tree and covers a big land area under its shade.

Chiuri in Nepal

Legend

- GPS data collected sites in the field
- Major Road
- Minor Road/ Trail
- 50184 No. of Chiuri trees in a District
- Chiuri Potential Forest
- Other Forest
- Administrative Area of Nepal

50 25 0 50 100 150 200 Kilometers

Scale 1:3,500,000

5.1 Major Chyuri Growing Areas in Nepal

As per the questionnaire survey conducted with key informants, the following VDCs are known to have considerable number of Chyuri trees (Table 2). In addition to the districts/VDCs listed in the Table below, a meager number of trees can also be found in other districts, like Jaire, Maila and Kalika VDCs of Humla, Thuhethata VDC of Panchthar, few places in Kathmandu and Lalitpur. But in these districts, Chyuri plants are either introduced as an ornamental plant (for example in Bhirkutimandap of Kathmandu) or sparsely occurred in natural habitat but their fruits are not commercially utilized by the local people. Hence, these districts are not considered as Chyuri potential districts.

Table 2: List of Districts and VDCs known to have Chyuri trees

Name of Districts	Major Chyuri Growing VDCs
Far Western Development Region	
Darchula	Tapoban, Seri, Latinath, Sikhar, Dhap, Bhagawati, Lali
Baitadi	Rupalli, Ballasau, Lekam, Basthi, Thalakanda, Mulpani, Bagalegado, Maurari, Pani, Khel, Neulali, Sittad, Rin, Katauje pani, Sri kedar, Srikot, Jonukhola, Dasarathchand, Jayamath, Dhunga
Dadeldhura	Alital, Sirsa, Gankhet, Navadurga, Asigram
Bajhang	Matela, Malumela, Rayal, Koiralkot, Kotbhairab, Parakatne, Dangaji, Banj, Pipalkot, Sunkuda, Bhairabnath, Maulali, Koiralkot
Bajura	Kolti, Badu, Kotila, Bai, Jagannath, Gotri, Sap-pata, Kuldevmandu, Barhabis, Brahmatola, Toli, Martadi, Jugada
Doti	Gajari, Berchhen, Talar, Ramilek, Bagechhana, Lana, Gadsera, Gopighat, Chauki, Pachnali, Budbuda, Kalikasthan, Chhyali, Muthbhara, Tijali, Jijadamund, Ganeshpur, BPNagar, Bokra, Goganpani, Sanagaun, Lamidada
Achham	Walanta, Dhungachalna, Nada, Torma, Jalpadevi, Lungra, Bhatgariya, Sonar, Manarka, Siddeswor, Simri, Marku, Garbudha, Tijali, Lulekh, Salkot, Gainihgaun, Lekh, Latamandau, Nanlek
Kailali	Sahajpur, Nigali, Khairala, Mohanyal, Pandron, Sugurkhal
Mid-Western Development Region	
Surkhet	Lagam, Betang, Lekfarsa, Gumi, Bidhyapur, Guthu, Gadhi, Kunathari, Bijaura, Pokharidanda, Dahachaur, Lekgaun, Mehelkuna, Dasarathpur, Satakhani, Malarani, Lekparajul, Khanikhola, Rajena, Kamrichaur, Babiyachaur, Chhapre
Jajarkot	Khalanga, Kankrigaun, Rimna, Syala, Kudu, Bordgaun, Chhapragaun, Dajya, Dusera, Kalpat, Dadagaun, Goiri, Jungathapa, Maidya, Pali, Chiurigaun
Dailekh	Kusapani, Malika, Seri, Paganath, Bindhebasini, Lankuri, Triveni, Salleri, Chamunda, Bhairikalika
Salyan	Khairagaun, Suikot, Kalagaun, Chisapani, Mulkhola, Lekhpokhara, Tirbeni, Kharkhola, Falange
Pyuthan	Tirang, Khala, Hansapaur, Bijuwar, Baghdula, Dharmawati, Asurkot, Dhobighat, Jaspur, Chuja, Fatali, Maranthada, Torbang, Markabang
Rukum	Bathikot, Athabiskot, Jimlai, Chaurjhari, Garayala, Sakh, Khara, Ruwa, Moru, Rimna
Rolpa	Khungri, Dungri, Ghartigaun, Jaimakasala, Binabang, Jedubang, Jungar, Sulichaur, Ghodagaun, Jhenam, Nuwagaun, Wot, Jinawang, Masina
Dang	Rampur, Lakshmanpur, Hapur, Bijauri, Halbar, Pabannagar, Purandhara, Bagmare, Hansipur, Saiga, Siuja, Kavre, Loharpani, Ghorahi, Tulasipur

Western Development Region	
Arghakhanchi	Nuwakot, Pali Dhanichaur, Buddichaur, Dikura, Tindanda, Khanakdaha, Thadadaha, Sitapur, Kathemaidan, Lutipokhari, Padena, Chitika, Balkot, Dhatibang, Gulding, Narapani, Rujje
Gulmi	Thorga, Hardineta, Bheduwa, Chovrabesi, Simichaur, Ruru, Kharjeng, Dauha
Myagdi	Rakhu, Piple, Ghatang, Bhagawati, Ratnechaur, Jyamurkot
Baglung	Bhimgithe, Burtibang, Gwalichaur, Daga, Sisakhani, Malma, Hatiya, Darling, Rajkut, Adhikarichaur, Dhulubeeskot, Rangkhani, Chhisti, Jaidi
Parbat	Mallan, Shivalaya, Pang
Palpa	Bhuvanpokhari, Chhahar, Telanga, Chhahara, Masyang, Dovan, Gothari, Thimure, Aryabhanjyang
Syangja	Chapakot, Srikrishangandaki, Sekhamsankhar, Galyang, Kuwakot, Pakubaji, Kolma, Tulasibhyang, Jagatradevi, Peripheri of municipality area
Kaski	Rupakot, Deurali, Thumki
Tanahu	Deorali, Dharmapani, Kota, Baidi, Chhirchhipe, Pokharibhanjyang, Arundaya, Sising, Sundhara, Majhkot, Kausivapur, Bhirkot
Gorkha	Magasing, Ghyalchowk, Tailchowk, Taklong, Bhulchauk, Manakamana, Batase, Dhairung
Lamjung	Sribhanjyang, Nauthar, Chakratirtha, Bholetar, Udipur, Bharte, Gauda, Bhulbhule
Nawalparasi	Debchuli, Divyapuri, Rakachuli, Bulingtar
Central Development Region	
Chitwan	Shaktikhor, Siddi, Korak, Chandebhanjyang, Kaule, Darechowk, Dahakhani
Makwanpur	Kagada, Raptirag, Charikhet, Bharta, Manahari, Khairan, Faparbari, Namtar, Gogane, Kalikatar, Bhaise, Ipapanchakamya
Dhading	Jogimara, Mahadevsthan, Benighat, Dhusa, Gajuri, Salang
Nuwakot	Raluka, Kharne, Panchakanya, Kabilas, Bungtang, Berschet, Sikre, Urleri, Sunkhani
Rasuwa	Dhaibung, Laharepauwa, Dadagaun, Thulagaun, Sarthali, Bhorle, Ramche, Chilime
Kavre	Kanpur, Kalapani, Sarsiunkharka, Katunje, Kosidekha, Rapcha, Kharelthok, Timal, Dapcha
Sindhuli	Dandi, Gurase, Bhadrakali, amale, Bastipur, Netrakali, Santeswori, Siddeswor, Mahadevsthan
Ramechhap	Lyanglyang, Betini, Bhangeri, Babiyokharka, Sanne, Pakarbas, Makaghung
Dolakha	Namadi, Betali, Banchare
Eastern Development Region	
Okhaldhunga	Jyamire, Kuntadevi, Baruneswor, Balkhu, Taluwa, Palapu, Kalika
Khotang	Matim, Temma, Dadagaun, Simpani, Pauwa
Udaypur	Murkuti, Mainamaini
Dhankuta	Harde, Tamrang, Vhartang, Rajarani, Jitpur, Arkauli, Chhintang, Salum, Ahale
Bhojpur	Ghodetar, Ranibos, Homtang, Simrang, Khairang, Patlepani, Hansapur, Devantar, Khaba, Lekhkharka, Dumbana, Basdim
Sankhuwasabha	Kharang, Tamafok, Mamling, Tumlingtar
Ilam	Jirmale, Irautar, Siddhithumka, Nepaltar, Thutapukka
Terhathum	Sagaranti, Thoklung, Isibu, Chandanda
Taplejung	Niguradin, Fulbari, Dhungrikhe, Sinam, Sablakhu, Chyaksibote

5.2 Estimated Number of Chyuri Trees in Nepal

The number of Chyuri trees per hectare of land varies greatly depending upon the climatic conditions, soil types, slope aspect and other socio-environmental conditions of the area. In some Chyuri threshold areas, the number of tree per hectare was recorded as 23, while in others there were 97 trees. Based on the data obtained from the sample plots, the average number of tree was estimated as 5,593 per square kilo meter. Practical Action (2006) recorded from 37-90 trees with average of 40 trees per hectare.

As per the statistical calculation of the Chyuri potential forest, the total number of Chyuri trees in the country is estimated at 10.8 millions. Of which, 5.6 million trees (52%) are in flowering stage. The highest number of trees are found in the mid western development region (MWDR), which is followed by far western development region (FWDR), western development region (WDR) and central development region (CDR), respectively. Whereas, the eastern development region (EDR) consists only 7% of the total trees found in Nepal. Table 4 presents the estimated number of trees in each of the district along with data on total area of the district, forest coverage, areas of Chyuri potential forest and approximate area of Chyuri forest.

The GIS maps for each of the district listed in the Table 3 have been developed to show the estimated number of trees, Chyuri potential areas and forest coverage. The maps are presented in the Annex 2.

Table 3: Estimated Area of Chyuri Forest and Number of Trees

District	Area	Forest Area	Area of Chyuri Potential Forest	Approximate Area of Chyuri Forest	Estimated No. of Chyuri Trees
Achham	1680	1152	306.13	101.02	565021
Baitadi	1599	827	282.07	93.08	520614
Bajhang	3422	1116	104.82	34.59	193465
Bajura	2188	1129	123.72	40.83	228349
Dadeldhura	1538	1213	245.94	81.16	453929
Darchula	2322	1010	104.06	34.34	192063
Doti	2025	1538	341.88	112.82	631004
Kailali	3235	2038	166.11	54.82	306588
Total of FWDR	***18009***	***10023***	***1674.73***	***552.66***	***3091032***
Dailekh	1502	1364	120.54	39.78	222479
Dang	2955	873	281.31	92.83	519211
Jajarkot	2230	1787	345.6	114.05	637870
Pyuthan	1309	935	287.6	94.91	530820
Rolpa	1879	1375	324.45	107.07	598834
Rukum	2877	1607	291.11	96.07	537299
Salyan	1462	922	238.91	78.84	440954
Surkhet	2451	2077	208.14	68.69	384162
Total of MWDR	***16665***	***10940***	***2097.66***	***692.23***	***3871630***

District	Area	Forest Area	Area of Chyuri Potential Forest	Approximate Area of Chyuri Forest	Estimated No. of Chyuri Trees
Arghakhanchi	1193	919	187.29	61.81	345679
Baglung	1784	1108	141.92	46.83	261940
Gorkha	3610	984	76.69	25.31	141546
Gulmi	1149	502	36.25	11.96	66906
Kaski	2017	969	57.27	18.9	105703
Lamjung	1692	932	76.23	25.16	140697
Myagdi	2297	916	40.64	13.41	75009
Nawalparasi	2162	1099	61.4	20.26	113325
Palpa	1373	935	107.7	35.54	198781
Parbat	494	213	38.89	12.83	71779
Syangja	1164	224	37.99	12.54	70118
Tanahu	1546	777	42.99	14.19	79346
Total of WDR	***20481***	***9578***	***905.26***	***298.74***	***1670829***
Chitwan	2218	1300	117.12	38.65	216167
Dhading	1926	721	64	21.12	118124
Dolakha	2191	698	64.01	21.12	118143
Kavre	1396	497	34.52	11.39	63713
Makwanpur	2426	1781	202.56	66.84	373863
Nuwakot	1121	290	75.98	25.07	140236
Ramechhap	1546	509	43.04	14.20	79438
Rasuwa	1544	419	58.15	19.19	107327
Sindhuli	2491	1936	107.84	35.59	199039
Total of CDR	***16859***	***8151***	***767.22***	***253.18***	***1416050***
Bhojpur	1507	680	43.8	14.45	80841
Dhankuta	891	286	39.22	12.94	72388
Ilam	1703	1045	56.66	18.7	104577
Khotang	1591	691	32.04	10.57	59136
Okhaldhunga	1074	405	54.25	17.90	100129
Sankhuwasabha	3480	1318	74.64	24.63	137762
Taplejung	3646	891	37.33	12.32	68900
Terhathum	679	219	48.9	16.14	90254
Udaypur	2063	1664	27.19	8.97	50184
Total of EDR	***16634***	***7199***	***414.03***	***136.63***	***764171***

6. RESOURCE POTENTIAL FOR ENTERPRISE PROMOTION

There is a wide variation in production potential of Chyuri trees. For example, Sundriyal and Sundriyal (2003) reported the average fruit yield of 13.7 kg/tree, with minimum of 5 kg/tree to maximum of 155 kg/tree in different girth class sizes. Bhatta, P (1996) reported average fruit yield of Chyuri tree in Baitadi district as 500 kg, with minimum of 140-150 kg (5-8 doko) and maximum of 750-800 kg (20-25 doko) fruits per tree. Whereas, Practical Action (2006) reported average fruit yield as 100-800 kg per hectare or 1-14kg per tree. Similarly, Bhatta, DD (1996) reported the yield of butter at 50-125 kg per tree and production potential of 'gur' at 30-37 kg per tree. While Bhatta, P (1996) estimated the yield of butter per tree at 52.5 kg and of 'gur' at 2.5 kg; his estimation based on factor ratio: 1 kg butter= 2 kg seeds=8kg fruits. Based on their questionnaire survey, Bhatta and Adhikari (2003) reported that from a single tree one can get 694 kg of fruits containing 240 kg seeds, which yield 127 kg of butter and 103 kg oil cake. Since the range of production is very high, it is not so easy to make accurate estimation of the quantity of fruits and other Chyuri products in an area.

In the present study, an effort has been made to assess the production potential based on the data and figures presented in Box 5.

Box 5: Figures for Estimating Quantity of Chyuri Products

Figures	Source
Total number of trees in the country = 10.8 million	Estimated based on multiple research methodology used in the present study
Number of fruit bearing trees in the country = 5.6 million	Based on the field survey carried out for the present study
Average fruit yield per tree = 67.33 kg	Based on interviews conducted with Chyuri collectors/processors for the present Study)
Number of fruits per Kg = 100-125 (112.5 average)	Bista P B, 1996
Number of seeds per Kg = 1035	Present study (Numbers counted during the field survey)
Production of Chyuri butter per 100 kg seeds= 39.35kg	Based on interviews conducted with Chyuri collectors/processors for the present Study)
Yield of oil = 42-47% of seed per weight	Khanka et al, 2009
Palmitic acid content of see fat = 56.6%	Khanka et al, 2009
Number of flowers per fascicle = 59	Joshi and Pechhacker, 2002
Quantity of nectar secreted per flower/day = 27.9mg	Joshi and Pechhacker, 2002
Production of nectar per tree = 13 litre	Estimation based on various data sources (Av. yield per tree, No. of fruits per kg, No. fruits per fascicle, Nectar secretion per flower per day, flowering period)

According to the statistical extrapolation there are total of 5.6 million Chyuri tree at fruit bearing stage in the country. If the average fruit yield per tree is considered as 67.3 kg, then the total fruit production of the country could be estimated as 378,605 MT. Considering that 4 kg of fruits give 1 kg seeds; the total quantity of seeds and butter produced throughout the country could be 94,651 MT and 37,245 MT respectively. It is also extrapolated that one Chyuri tree bears 30,298 flowers, and each single flower secrets 27.9 micro litre of nectar per day. If sufficient numbers of honeybee colonies are managed in Chyuri threshold areas, approximately 17,825 MT of Chyuri honey can be produced in the country (Table 4).

Table 4: Resource Potential for Chyuri-based Enterprises

District	**Fruit bearing**	**Estimated Quantity of Chyuri Products (in MT)**			
		Fruits	**Seed**	**Butter**	**Honey**
Achham	293811	19782	4946	1946	931
Baitadi	270719	18228	4557	1793	858
Bajhang	100602	6774	1693	666	319
Bajura	118741	7995	1999	786	376
Dadeldhura	236043	15893	3973	1563	748
Darchula	99873	6724	1681	662	317
Doti	328122	22092	5523	2173	1040
Kailali	159426	10734	2684	1056	505
Total of FWDR	***1607337***	***108222***	***27055***	***10646***	***5095***
Dailekh	115689	7789	1947	766	367
Dang	269990	18178	4545	1788	856
Jajarkot	331692	22333	5583	2197	1051
Pyuthan	276026	18585	4646	1828	875
Rolpa	311394	20966	5242	2063	987
Rukum	279395	18812	4703	1851	886
Salyan	229296	15439	3860	1519	727
Surkhet	199764	13450	3363	1323	633
Total of MWDR	***2013248***	***135552***	***33888***	***13335***	***6382***
Arghakhanchi	179753	12103	3026	1191	570
Baglung	136209	9171	2293	902	432
Gorkha	73604	4956	1239	488	233
Gulmi	34791	2342	586	230	110
Kaski	54966	3701	925	364	174
Lamjung	73162	4926	1232	485	232
Myagdi	39005	2626	657	258	124
Nawalparasi	58929	3968	992	390	187
Palpa	103366	6960	1740	685	328
Parbat	37325	2513	628	247	118
Syangja	36461	2455	614	242	116
Tanahu	41260	2778	695	273	131
Total of WDR	***868831***	***58498***	***14625***	***5755***	***2754***

District	*Number of Fruit Bearing Tree*	*Quantity of Fruits*	*Quantity of Seeds*	*Quantity of Butter*	*Quantity of Honey*
Chitwan	112407	7568	1892	745	356
Dhading	61424	4136	1034	407	195
Dolakha	61434	4136	1034	407	195
Kavre	33131	2231	558	219	105
Makwanpur	194409	13090	3272	1288	616
Nuwakot	72923	4910	1227	483	231
Ramechhap	41308	2781	695	274	131
Rasuwa	55810	3758	939	370	177
Sindhuli	103500	6969	1742	686	328
Total of CDR	***736346***	***49578***	***12395***	***4877***	***2334***
Bhojpur	42037	2830	708	278	133
Dhankuta	37642	2534	634	249	119
Ilam	54380	3661	915	360	172
Khotang	30751	2070	518	204	97
Okhaldhunga	52067	3506	876	345	165
Sankhuwasabha	71636	4823	1206	474	227
Taplejung	35828	2412	603	237	114
Terhathum	46932	3160	790	311	149
Udaypur	26096	1757	439	173	83
Total of EDR	***397369***	***26755***	***6689***	***2632***	***1260***
Grand Total	**5623130**	**378605**	**94651**	**37245**	**17825**

Table shows tremendous scope and resource base for establishment of micro and small enterprises in the rural areas. Some of the key areas for establishment of Chyuri based enterprises are discussed below:

6.1 Chyuri butter based enterprises

There are number of value added products which can be made out of Chyuri butter. If proper training and technical backstopping support is provided, the rural farmers can make these products locally. At present, Chyuri dwellers manage to harvest only a small quantity of fruits. Since the trees are very tall and mostly found in slopes it is hard and tedious job to harvest fruits. It is also difficult to extract butter with traditional tools and techniques. Hence, keeping in view the increasing demands of Chyuri butter for making value added products, it seems necessary to set up of improved oil expeller for the commercial production of Chyuri butter.

The production potential of Chyuri butter in the country is estimated at 37,245 metric tonnes. The price of butter in the villages is NRs 150/kg (ranged from NRs 70 to 200 per kg), which means the total quantity produced in the country is worth of NRs 5,587 million. If all the potential quantity of butter is harnessed,

hundreds of micro and small enterprises can be operated in the villages. An enterprise that targets to sell herbal soaps (@NRs 20 per 80 gram piece) worth of 200,000 require to produce 10,000 pieces of soaps. Taking commonly used soap making formula (Box 6) into consideration it can be said that in one batch of preparation 1.67 kg of butter is needed to make 72 pieces of soaps. That means to make 10,000 pieces of soaps a total of 232 kg Chyuri butter is required.

Box 6: Major Ingredients of Chyuri Soap

Chyuri butter	1.67 kg
Coconut oil	1 kg
Sugar syrup	1.67 kg
Castic Soda	1.5 kg
Castor oil	3.3 g
Essential oils	1.5 g (varies as per specification)

From one batch of above ingredients 72 soaps are made

(Source: Trip Report of Dr. Bhimendra Katawal and Narendra Rasaily, MEDEP)

Even if 50% of the total potential quantity of butter is utilized for soap making, hundreds of herbal soap making enterprises can be established in the country. At least one medium sized enterprise can also be established in each of the development region for making cosmetic and skin care products. In recent years, Chyuri butter and other vegetable oils are being popularly used in pharmaceuticals, cosmetics, herbal soaps and Palmolive industries. Some Fair Trade Group (FTG) members and herbal shops are already engaged in processing and marketing Chyuri-based products. According to Mahaguthi that purchase Chyuri soaps from micro-entrepreneurs of Pyuthan, there is good market potential for export of Chyuri herbal soaps, but inconsistent quality, irregular supply and untimely delivery of the products pose problem in dealing with export market[1]. To make optimum use of the resources there is a need to create awareness, build capacity and strengthen market linkages (both backward and forward).

6.2 Beekeeping and honey processing enterprises

The next enterprise that directly depends upon Chyuri forest is beekeeping. Traditionally, beekeeping with native hive bee, *Apis cerana* is very common in areas where Chyuri trees are prevalent. According to one survey, beekeepers in Chyuri threshold areas can earn as much as one third of total cash income from the sale of honey and beeswax (Gurung et al, 2001). Since beekeeping requires minimal start up investment and generally yields profits within the first year of operation, it is very suitable for poor and low income groups. Moreover, honeybees create win-win situation between environment and income generation; they help maintain biodiversity by providing pollination services and increase incomes through the production of honey and other bee products.

[1] Personal communication with Sunil Prajapati, Executive Director, Mahaguthi

Honeybee Colonies Migrated from Chitwan to Dang for Production of Chyuri Honey

Honey produced by bees from the flowers of Chyuri trees has fine granules, sweet soft aroma and pleasant taste. It is one of the most popular unifloral honeys that fetches good price in the local market and has high demand in the international market. Chyuri is among the very plants that have long blooming period and provide abundant nectar for bees. The nectar secretion per flower per day ranged from 13.8 to 51.9 (average 27.87) microlitre with solute concentration of 25-44% (Joshi and Pechhacker, 2002). The flowers are intensively visited by honeybees for collection of nectar and its pollen. As a rich source of nectar, coupled with a long blooming period, Chyuri provides enourmous opportunity for the production of honey (Joshi and Pechhacker, 1999; Partap, U, 1997).

In recent years, Chyuri threshold areas, like Dang valley, Lothar in Makwanpur, Shaktikhor in Chitwan have become favorite destinations for migration of *Apis mellifera* colonies. As Chyuri grows in pristine land and produce enourmous quantity of nectar, it is highly feasible to produce organic honey from the nectar of Chyuri flowers. Keeping in view the number of Chyuri trees available in the country, approximately 17,825 metric tonnes of Chyuri honey can be harvested. But at present, the beekeepers are able to harness less than 1 % of the total potential. This is mainly due to lack of road access to various Chyuri threshold areas, improper placement of bee colonies (in some of the Chyuri threshold areas there are only a few colonies of bees to gather nectar, whereas in other places a large number of migrated bee colonies are placed for honey production) and lack of adequate skills to mange bees and harvest honey.

With proper training, technical backstopping and development of infrastructure beekeepers can earn significant amount of cash from the production of honey and other bee products. Even if only 50% of total honey production potential is achieved, beekeepers can generate significant amount of revenue from the sale of honey alone. This can generate employment opportunities to a large number of people

in various areas of apiculture (e.g. hive carpentry, beekeeping, colony migration, and honey collection, processing and marketing).

6.3 Nectar and Pulp Based Enterprises

Chyuri is among a very few plant from which flowers nectar can be collected without aid of honeybees (Crane). People, especially in Far West (e.g. Darchula, Baitadi and Dadeldhura districts) shake the flowers to collect nectar. This nectar after prolonged steaming is made into sugar candy, locally called 'gur' (Joshi and Pechhacker, 2002). This sugar candy is highly prized for its nutritive value and is also used to cure several diseases (Awasthi, 1994).

As estimated in the Table 4, Nepal offers potential for the production of 378,605 metric tons of Chyuri fruits. In most areas fruits are eaten fresh. At present, only small amount of fruit pulp is used for edible purposes by local people. In some areas, fruit juice is traditionally extracted to make rakshi (locally brewed alcohol). Making squash by adding sugar and some preservatives is also taking place in some areas with the support of development agencies. Yet, the huge amount of pulp gets wasted due to lack of appropriate processing techniques and poor access to market. As most of the fruits ripen more or less at the same time, local population cannot consume the whole production. There is strong need to provide training and technical backstopping support for making squash or fruit juice from the Chyuri fruits. The promotion of squash making techniques and its packing and marketing can lead as small but peculiar trade in the country. Chyuri pulp can be used both in confectionery and juice factory.

6.4 Paper plates and other enterprises

Disposable plates can be made from the Chyuri leaves which can replace the use of paper plates in the market to some extent. It can be developed as small enterprise for local as well as distant markets. Chyuri also provides good quality durable wood for making furniture, but it is not encouraged to fell down the trees for harvesting timber. Since it is slow growing trees it is also not good cut the young branches, while collecting leaves and fruits.

7. POTENTIAL FOR EXPORT OR IMPORT SUBSTITUTION

Palm oil is popularly used in various industries across the world. Nepal's neighbouring countries (China, India, Pakistan and Bangladesh) are among the major importers of palm oil (Table 5). China is on the top of the list that imports palm oil worth of US$ 3.78 billion, which is followed by India with total import value US$ 1.6 billion. Since palmitic acid content of Chyuri fat is 56.6% (Khanka et al, 2009), its butter can be used as substitute of palm oil in several industries. Various reports and anecdotal evidences suggest that Chyuri butter has unique characteristics, which are better suited for making skin care creams and other cosmetic products. If Chyuri is properly processed and packed it can offer strong potential not only to substitute the import of palm oil, but also finds its place in export market.

Table 5: Major Countries Importing Palm Oil (Source FAOSTAT**)**

Countries	Quantity (tonnes)	Value (1000 $)
China	5223369	3784334
India	3514900	1626335
Pakistan	1710437	914004
Bangladesh	1728006	772777
Germany	1076393	763634
Netherlands	1237817	736589
United States of America	787825	530072
Russian Federation	575605	455401
Japan	532209	389910
Islamic Republic of Iran	448057	377281
Ukraine	476809	372991
United Kingdom	491944	359339
Viet Nam	457616	357396
Italy	507622	348385
United Arab Emirates	420901	342271
Malaysia	435845	320029
Kenya	415970	314210
Belgium	384574	298032
Myanmar	367794	290296
Turkey	365629	263039

In recent years, Chyuri has already become a resource of commercial interest for several national and international companies/entrepreneurs. Chyuri butter is increasingly used in making soaps, creams, shampoos and other value added products. Chyuri butter offers great potential for import substitution of palm oil and other base material that are mainly used for their saponin. According to the data of Trade, Export and Promotion Centre, Nepal currently imports huge quantity of palm oil and animal fats and oils for industrial use. The import value of these products in fiscal year 2008/2009 was about 15 Billion Rupees (Table 6). Nepal also imports huge quantity of shampoos, soaps and surface active products from third countries. The total import value of these products in year 2008/2009 was about 1.8 billion Rupees (TEPC). This value of import can be substantially reduced if proper technical support is provided to make soaps, shampoos and surface active products using Chyuri butter as one of the basic raw materials.

Table 6: Import of Palm Oil, Animal or Vegetable Fats and Oil Seeds in Nepal

Items Imported	Import Value (NRs)	
	Year 2008/2009	Year 2007/2008
Crude palm oil	2,721,836,414	5,234,037,286
Palm oil	171,706,005	267,158,502
Animal or vegetable fats and oils and their clearage products	11,740,020,707	Na
Oil seeds and oleaginous fruits	38,829,074	Na
Vegetable fats and oils, partly or wholly hydrogenated	32,135,088	Na

8. CONCLUSION AND RECOMMENDATIONS

According to the findings of present study, there are about 10.8 million Chyuri trees distributed in 46 districts of the country; of which 5.6 million (52% of the total trees) are in flowering/fruit bearing stage. The total production potential of Chyuri butter, which is commercially the most important Chyuri product, is estimated to be 37,245 metric tonnes, which has economic value of over 5 billion Nepali Rupees. Similarly, the honey production potential of Chyuri trees in the country is about 17,285 metric tonnes.

Keeping in view the international market demand for vegetable oil/butter/palm oil, *Chyuri* butter offers strong potential for import substitution of palm oil and stands as unique raw material for production of cosmetics, skin care creams and other high value products. Having fine granules, pleasant taste and unique flavor, *Chyuri* honey also stands as niche product for export market. However, at present the traders have not been able to fully tap the market, despite the increasing recognition of herbal products in the international market. There is general lack of awareness among the producers/processors and traders about the availability and potential of Chyuri products. In some areas there is a crowd of beekeepers to forage bees for the production of Chyuri honey, where as in other areas there is not even a single beekeeper. Similarly, in few districts there are number of middlemen and processors competing to buy Chyuri butter, while in other districts Chyuri dwellers find it difficult to sell their butter.

Regarding conservation and sustainable utilization of Chyuri forest, only a few communities, like *Chepang* have developed management systems for this tree species in its natural habitat and are also trading Chyuri products through community groups and cooperatives. But in many places, people still chop off the trees/young branches to feed green leaves to their cattle. They also chop off the branches to collect fruits. In those areas, plant dwellers and fruit collectors need to be educated about forest associations and adverse impact of felling of branches for fruit collection.

It seems that the selling of seeds brings minimum return to the Chyuri dwellers as the existing oil processing techniques are time and labour consuming, and the expellers are not effective enough to get the expected quantity of butter from the seeds. Therefore, some supports are required to improve processing techniques and diversify products in the form of soaps, candles, etc. Chyuri dwellers are of the opinion that they could have earned more money had they managed to sell fruits or add value on it. Since fruits ripen all at the same time, people cannot manage to consume them all. Though fruits taste good but it is difficult to bring the fruits to the market due to fairly low keeping quality. Therefore, it would be interesting to look at the prospect of making, juice, squash and jams from Chyuri fruits.

It is noted that the nectar of Chyuri remained under utilized. Traditionally, people in the far west used to shake the flowers for collection of nectar to make 'Gur' but in these days this product is hardly available in the market. Hence, this could also an interesting area to look at whether 'Gur' making enterprise can be economically viable.

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Annex 1: Botanical Description of Chyuri

Map of Nepal Showing Chyuri Forest

Far Western Development Region

Mid Western Development Region

Western Development Region

Central Development Region

Eastern Development Region

A BOTANICAL *and* ECONOMICAL ACCOUNT *of* BASSIA BUTYRACEA, *or* EAST INDIA BUTTER TREE

BY W. BOXBURGH, M.D.

(Asiatick Researches, vol.8, 499-510, **1809**)

BASSIA BUTYRACEA

Polyandria Monogynia

GENERIC CHARACTER

CALYX beneath, four or five leaved. Corol, one petaled: Border about eight cleft. Berry superior, with from one to five Seeds.

Bassia Butyracea. ROXBURGH.

Calyx five-leaved; Stamens thrity or forty, crowning the subcylindric tube of the Corol.

Fulwah, Phulwarah, or *Phulwara*, of the inhabitants of the Almorah hills, where the tree is indigenous. Flowering time, in its native soil, the month of *January*; Seeds ripe in *August*.

Trunk of the larger trees, straight, and about five or six feed in circumference. Bark of the young branches smooth, brown, and marked with small ash-coloured specks.

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Leaves alternate, about the ends of the branchlets, petioled, obovate-cuneate, obtuse-pointed, entire; smooth above, villous underneath; veins simple; and parallel; length, six to twelve inches; breadth, three to six.

Petioles, from one to two inches long.

Stipules, if any, minute, and caducous.

Flowers numerous, round the base of the young shoots, and from the axils of the lower leaves, peduncled, large, pale-yellow, drooping.

Calyx, four, five, or six leaved (five is by far the most common number); ovate, obtuse, covered externally with ferruginous pubescence, permanent.

Corol; tube subcylindric, length of the calyx; border of eight, spreading, oblong, obtuse divisions, longer than the tube.

Stamens; filaments from thirty to forty, about as long as the tube of the Corol, and inserted on its mouth. Anthers linear-oblong.

Pistil, germ conical, (ten or twelve celled, one seeded,) downy, surrounded with a downy nectarial ring. Style longer than the stamens; stigma acute.

Berry oblong, generally pointed by a remaining portion of the style; smooth, fleshy, containing one, two, or three, rarely more, large seeds; the rest not ripened.

Seeds oblong, rather round than flat, but differ-

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ing in shape according to the number contained in each fruit; smooth, shining, light brown, with a long, lanceolate, lighter coloured, less smooth, umbilical mark on the inside.

This tree, which is rendered interesting on account of its seeds yielding a firm butyraceous substance, resembels *Bassia Latifolia*, (see *Coromandel* Plants, Volume I, No.19, also *Asiatic* Researchers, Volume I, Page 300,) so much as scarce to be distinguished from it, except by the Corol and Stamina.

Here (in *Bassia butyracea*) the Corol is of a thin texture, with a tube nearly cylindric, and border of eight, large, spreading, oblong segments. There (in *Bassia latifolia*) it is thick and fleshy, with a gibbous, indeed almost globular tube; and border of generally more than eight, small, cordate, rather incurved segments.

Here, the Stamina, from thirty to forty in number, have long filaments inserted on the mouth of the tube of the Corol. There they are fewer in number; have very short filaments, and are arranged in two, or three series, completely within the tube, to which they are affixed.

It may not be improper to notice here some other species of the same genus. The following Botanical description of *Bassia longifolia*. LINN. Mant. Page 563, I have been favoured with by Doctor KLEIN, of

Tranquebar, and the account of its economical uses by the Reverend Doctor JOHN, of the same place.

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DESCRIPTION *by* DOCTOR KLEIN

Calyx, Perianth: monophyllum, 4-partitum; laciniis ovatis, acutis, coriaceis, extus tomento ferrugineo obduetis, persistentibus.

Corolla monophylla, campanulata; tubo cylindraceo, inflato, carnoso, limbo 8-partito; laciniis lanceolatis, erectis.

Stamina, filamenta 16, brevissima, in duos ordines divisa, quorum octo ad incisuras laciniarum, octo in tubo corollae inserta. Antherae lineares, setaceae, acutae, extus pilosae, limbo breviores.

Pistil: Germen superum, ovatum. Stylus sectaceus, corolla duplo longior. Stigma simplex.

Pericarp: drupa oblonga, 1-3 sperma, carnosa, lactescens. Seminibus subtrigonis oblongis.

Arbor magna; ramis sparsis, erectis, horizontalibusque.

Folia sparsa, petiolata, lanceolata, acuta, integerrima, glabra, venosa.

Flores longe-pedunculati, axillares, solitarii, et aggregati.

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ECONOMICAL USES *of the* OIL, *or* ILLEEPEI TREE

Bassia longifolia

BY THE REVEREND DOCTOR JOHN

1st. The oil, pressed from the ripe fruit, is used as a common lamp oil, by those who cannot afford to buy the oil of the coco-nut. It is thicker, burns longer, but dimmer, smoaks a little, and gives some disagreeable smell.

2d. It is a principal ingredient in making the country soap, and, therefore, often bears the same price with the oil of the coco-nut.

3d. It is, to the common people, a substitute for ghee, and coco-nut oil, in their curries and other dishes. They make cakes of it, and many of the poor get their livelihood by selling these sweet oil cakes.

4th. It is used to heal different eruptions, such as the itch, &c.

5th. The cake (or *Sakey*) is used for washing the head; and is carried, as a petty article of trade, to those countries, where these trees are not found.

6th. The flowers, which fall in *May*, are gathered by the common people, dried in the sun, roasted, and eaten, as good food. They are also bruised, and boiled to a jelly, and made into small

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balls, which they sell or exchange, for fish, rice, and various sports of small grain.

7th. The ripe fruit, as well as the unripe, is eaten by the poor, as other fruits. Of the unripe, the skin is taken off, and after throwing away the unripe kernel, boiled to a jelly, and eaten with salt and *Capsicum*.

8th. The leaves are boiled with water, and given as a medicine, in several diseases, both to men, and to cattle.

9th. The milk of the green fruit, and of the tender bark, is also administered as a medicine.

10th. the bark is used as a remedy for the itch.

11th. The wood is as hard, and durable, as teak wood, but not so easily wrought, nor is to procurable of such a length for beams, and planks, as the former; except in clay ground, where the tree grows to a considerable height; but, in such a soil, it produces fewer branches, and is less fruitful, than in a sandy, or mixed soil, which is the best suited for it. In a sandy soil, the branches shoot out nearer to the ground, and to a greater circumference, and yield more fruit. These trees require but little attention; beyond water them during the first two or three years, in the dry season. Being of so great use, we have here whole groves of them, on high, and sandy grounds, where no other fruit trees will grow.

12th. We may add, that the owls, squirrels, lizards, dogs and jackals, take a share of the

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flowers; but the vulgar belief is, that the latter, especially in the time of blossom, are apt to grow mad, by too much feeding on them.

Bassia *obovata*, FORSTER'S *Prod.* No. 200: a native of the Isle of *Tanna*, in the South Sea. Of this species, I posses no other account than the definition, which corresponds with the habit of the genus. If FORSTER has left us no account of the uses of the tree, it may be worth while to make inquiry, when an opportunity offers.

PARK'S *Shea*, or butter tree of *Africa*, we have reason, from his description, and figure, as well as from analogy, to suppose a species of this same genus. At page 352 (of his travels in the interior of *Africa)* he says, "The appearance of the fruit evidently places the Shea tree in the natural order of Sapotae, (to which *Bassia* belongs,) and it has some resemblance to the Madhuca tree (*Bassia latifolia*), described by Leiutenant CHARLES HAMILTON, in the *Asiatic* Researches, Volume I, page 300.

"The people were every where employed in collecting the fruit of the *Shea* trees, from which they prepare a vegetable butter, mentioned in the former part of this work*. These trees grow in great abundance all over this part of *Bambarra*.

* This commodity, *Shea toulou*, which, literally translated signifies *Tree-butter*, is extracted, by means of boiling water, from the kernel of the nut, has the consistence and appearance of butter; and is in truth an admirable substitute for it. It forms an important article in the food of the natives, and serves also for every domestic purpose in which oil would otherwise be used. The demand for it is therefore great. PARK'S Travels in *Africa*. Page 26.

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They are not planted by the natives, but are found growing naturally in the woods; and in clearing woodland for cultivation, every tree is cut down but the *Shea*. The tree itself, very much resembles the *American* oak, and the fruit, from the kernel of which, first dried in the sun, the butter is prepared, by boiling the kernel in water, has somewhat the appearance of a *Spanish* olive. The kernel is enveloped in a sweet pulp, under a thin green rind; and the butter produced from it, besides the advantage of its keeping the whole year without salt, is whiter, firmer, and to my palate, of a richer flavour, than the best butter I ever tasted made of cows milk. The growth and preparation of this commodity, seem to be amongst the first objects of *African* industry, in this and the neighboring states; and it constitutes a main article of their inland commerce." PARK'S Travels in *Africa*, page 202-3.

In the following account of *Bassia Butyracea*, by Mr. GOTT, we find the people of *Almorah* eat the dregs, left after the finer parts have been extracted; consequently there can be little doubt of the wholesomeness of the pure *vegetable butter* itself. The thick oil of *Bassia Latifolia*, and *longifolia*, the natives of various parts of *India*, either use alone, or mixed with ghee (clarified butter), in their diet.

On Captain HARDWICKE'S departure for *England*, in the beginning of 1803, he gave me a small quantity of the above-mentioned substance, observing, that the only account he could give me of it was, that it was reported to him to be a vegetable product from *Almorah*, or its neighborhood, where it is called *Fulwah*, or *Phulwarah*. In consequence of this information, I applied to

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Mr. GOTT (who is stationed in the vicinity of that country,) to make the necessary inquiries; and from him I procured an abundance of well preserved specimens, at various times, in leaf, flower, and fruit. From these, and that gentleman's account of the tree, and its product, the foregoing description, and the annexed figures, were taken.

The same sample, which I got from Captain Hardwicke, in *January* 1803, I have still by me. It remains perfectly sweet, both in taste and smell. Its flavour is that of cloves; having, I presume, been perfumed with that spice, previously to its falling into his hands, a practice mentioned in the following narrative. At this instant the thermometer is at ninety-five, and for these six weeks, it has rarely been below ninety, and has often risen to one hundred, or more, yet it continues about as firm as butter is in *England* during winter.

Mr. GOTT'S account of the tree, and its product, is as follows: -

The tree producing a fat-like substance, known in this country by the name of *Phulwah*, is a native of the *Almorah* hills, and known there by the same name. The tree is scarce, grows on a strong soil, on the declivities of the southern aspects of the hills below *Almorah*, generally attaining the height, when full grown, of fifty feet, with a circumference of six. The bark, of such specimens as I have been able to obtain, is inclined to smoothness, and speckled; it flowers in *January*, and the speed is perfect about *August*, at which time the natives collect them, for the purpose of extracting the above substance. On opening

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the shell of the seed or nut, which is of a fine chesnut colour, smooth, and brittle; the kernel appears of the size and shape of a blanched almond: the kernels are bruised, on a smooth stone, to the consistency of cream, or of a fine pulpy matter; which is then put into a cloth bag, with

a moderate weight laid on, and left to stand, till the oil, or *fat*, is expressed, which becomes immediately of the consistency of hog's-lard, and is of a delicate white colour. Its uses are in medicine; being highly esteemed in rheumatism, and contractions of the limbs. It is also much esteemed, and used by natives of rank, as an unction, for which purpose, it is generally mixed with an *Utr* of some kind. Except the fruit, which is not much esteemed, no other part of the tree is used.

This tree is supposed to bear a strong affinity to *Mawa*, (*Madhuca, or Bassia latifolia*;) but the oil or *fat*, extracted from the seeds, differs very materially. The oil from the *Mawa*, is of a greenish-yellow colour and seldom congeals. That from the *Phulwah* congeals, immediately after expression, is perfectly colourless; and, in the hottest weather, if melted by art, will, on being left to cool, resume its former consistency. The oil from the seed of the *Mawa*, if rubbed on woolen cloth, leaves as strong a stain as other oils or animal fat. The fatty substance from the *Phulwah*, if pure, being rubbed on woolen cloth, will leave no trace behind.

The oil of *Mawa* is expressed in considerable quantities, about *Cawnpoor*, and *Furruckabad*, and being mixed with, is sold as ghee.

This fatty substance very rarely comes pure from

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the hills, and receives more and more adulteration, (by adding the purest ghee,) as it passes down to the lower provinces : age gives it the firmness of pure tallow.

ADDITIONAL REMARKS BY THE SAME, IN CONSEQUENCE OF A FEW QUERIES TRANSMITTED TO MR. GOTT.

It is supposed there might be annually procured from twenty to thirty maunds, at the price of fourteen or fifteen rupees the maund.

1st. It is never taken inwardly as a medicine, nor is it used in diet; further than that the dregs, after the purer fatty substance is expressed, are eaten, as a substitute for ghee, by the peasants, or labourers, who extract the fat.

2d. I have some pure, which has been by me ten months, and it has neither acquired colour, nor bad smell.

3d. After it is imported into *Rohilkhund*, it is scented with *Utr*, (an essential oil,) and a little of the flour of the *Indian corn* (*Zea Mays*) is added, to increase its consistency. N.B. This flour is added on account of its peculiar whiteness.

4th. If it is clean, and free from dirt, it never undergoes any purification; if the contrary, it is heated, and filtered through a coarse cloth.

5th. The flowers are never used. The pulp of the fruit is eaten by *some;* it is of a sweet and flat taste.

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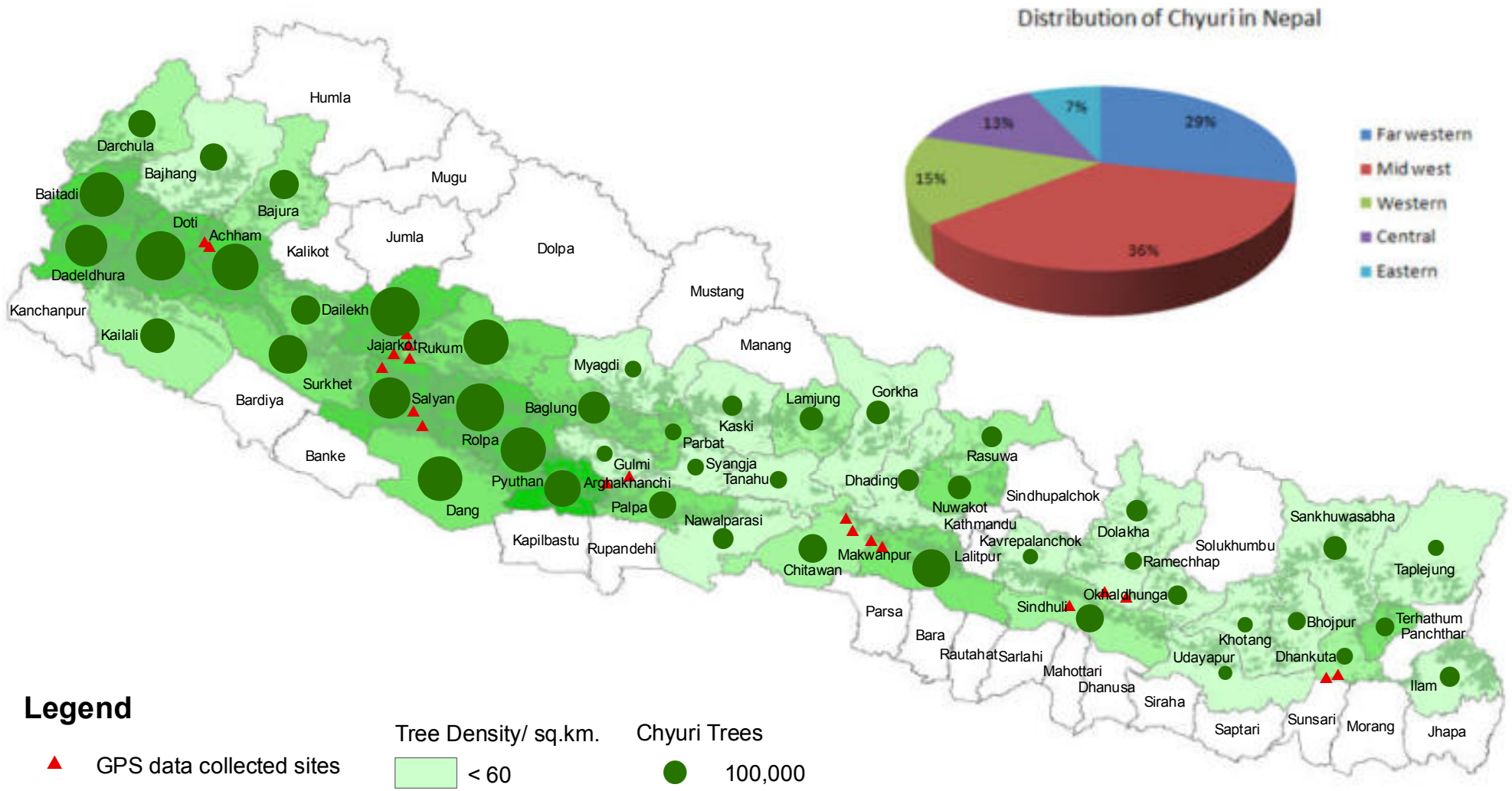
The timber is white, soft, and porous; and is never made any use of by the natives. It is nearly as light as the *Semul*, or cotton tree (*Bombar heptaphyllum*).

Chyuri in Nepal



Legend

- GPS data collected sites
- Major Road
- Minor Road/ Trail
- Chyuri Potential Forest
- Administrative Area

Tree Density/ sq.km.

- < 60
- 61 - 100
- 100 - 200
- 200 - 400
- > 400

Chyuri Trees

- 100,000
- 500,000

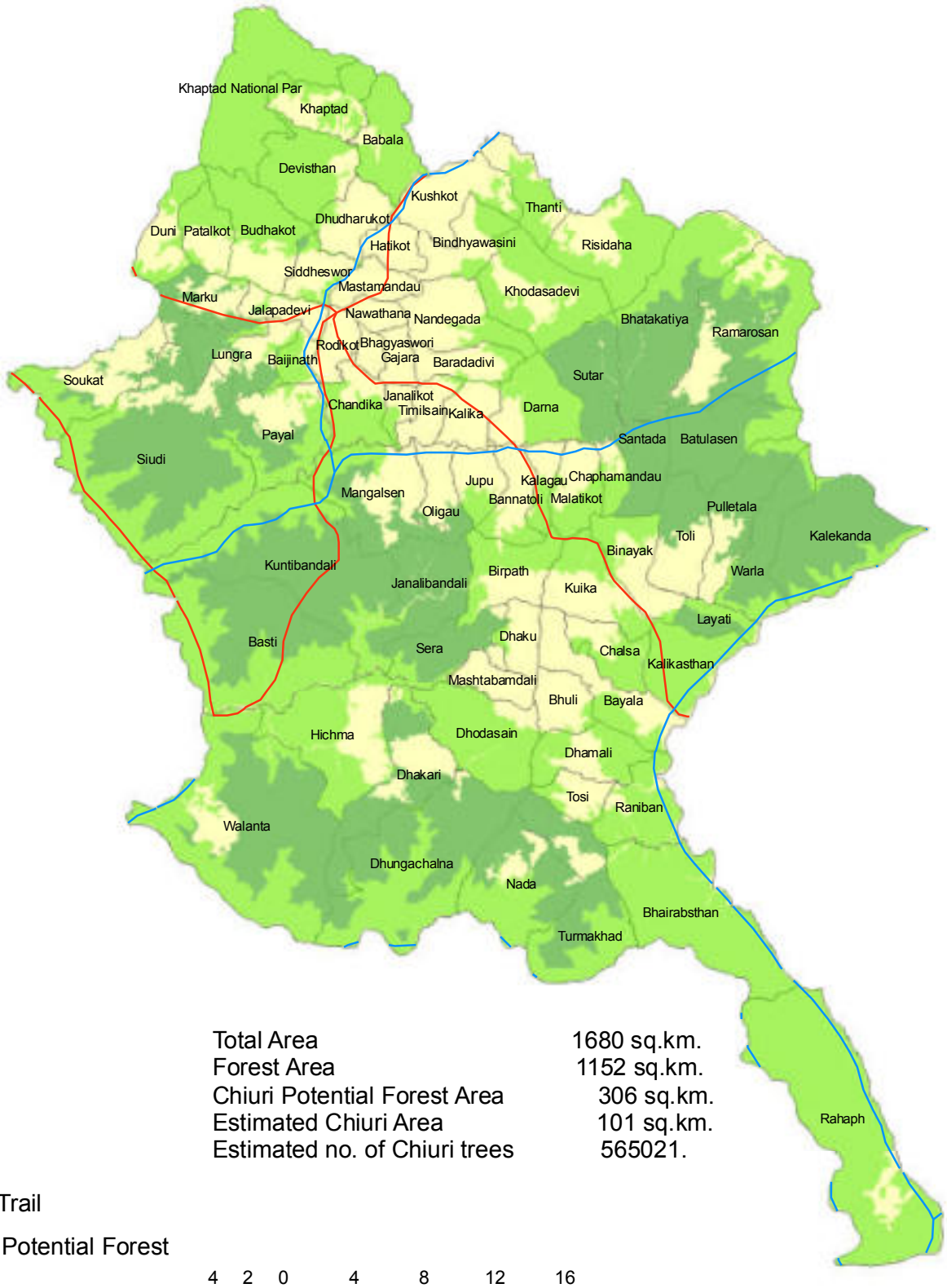
30 15 0 30 60 90 120 Kilometers

Scale 1:3,500,000

Total Area	147181 sq.km.
Forest Area	61296 sq.km.
Chyuri Potential Forest Area	5859 sq.km.
Estimated Chyuri Area	1934 sq.km.
Estimated no. of Chyuri trees	10813713

FAR WESTERN DEVELOPMENT REGION

Achham



Total Area	1680 sq.km.
Forest Area	1152 sq.km.
Chiuri Potential Forest Area	306 sq.km.
Estimated Chiuri Area	101 sq.km.
Estimated no. of Chiuri trees	565021.

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Achham District

4 2 0 4 8 12 16 Kilometers

Scale 1:350,000

Bajhang

Legend

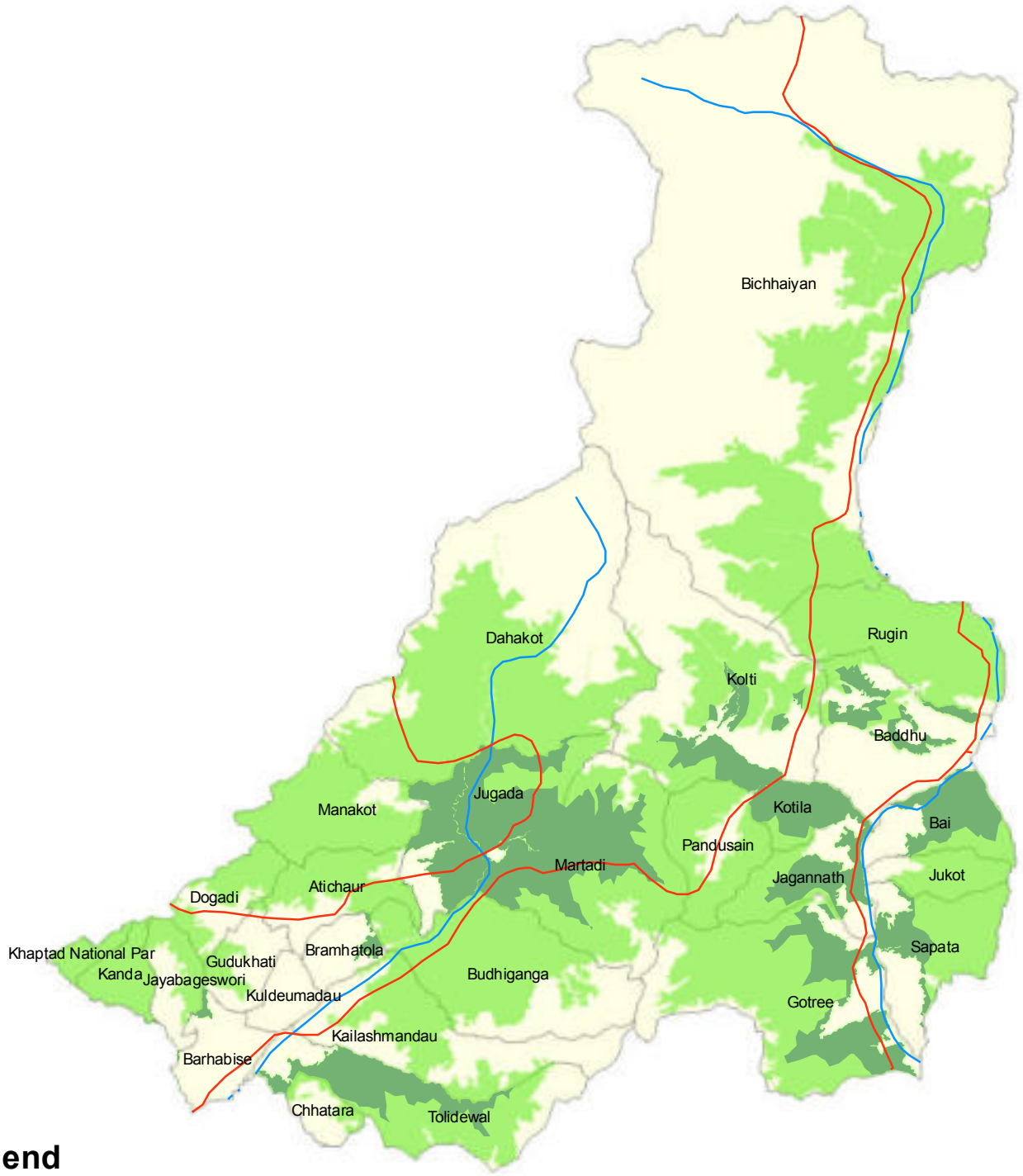
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Bajhang District

Total Area	3422 sq.km.
Forest Area	1167 sq.km.
Chiuri Potential Forest Area	105 sq.km.
Estimated Chiuri Area	35 sq.km.
Estimated no. of Chiuri trees	193465

4 2 0 4 8 12 16 Kilometers

Scale 1:450,000

Bajura



Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Bajura District

Total Area	2188 sq.km.
Forest Area	1129 sq.km.
Chiuri Potential Forest Area	124 sq.km.
Estimated Chiuri Area	41 sq.km.
Estimated no. of Chiuri trees	228349

4 2 0 4 8 12 16 Kilometers

Scale 1:400,000

Baitadi

Legend

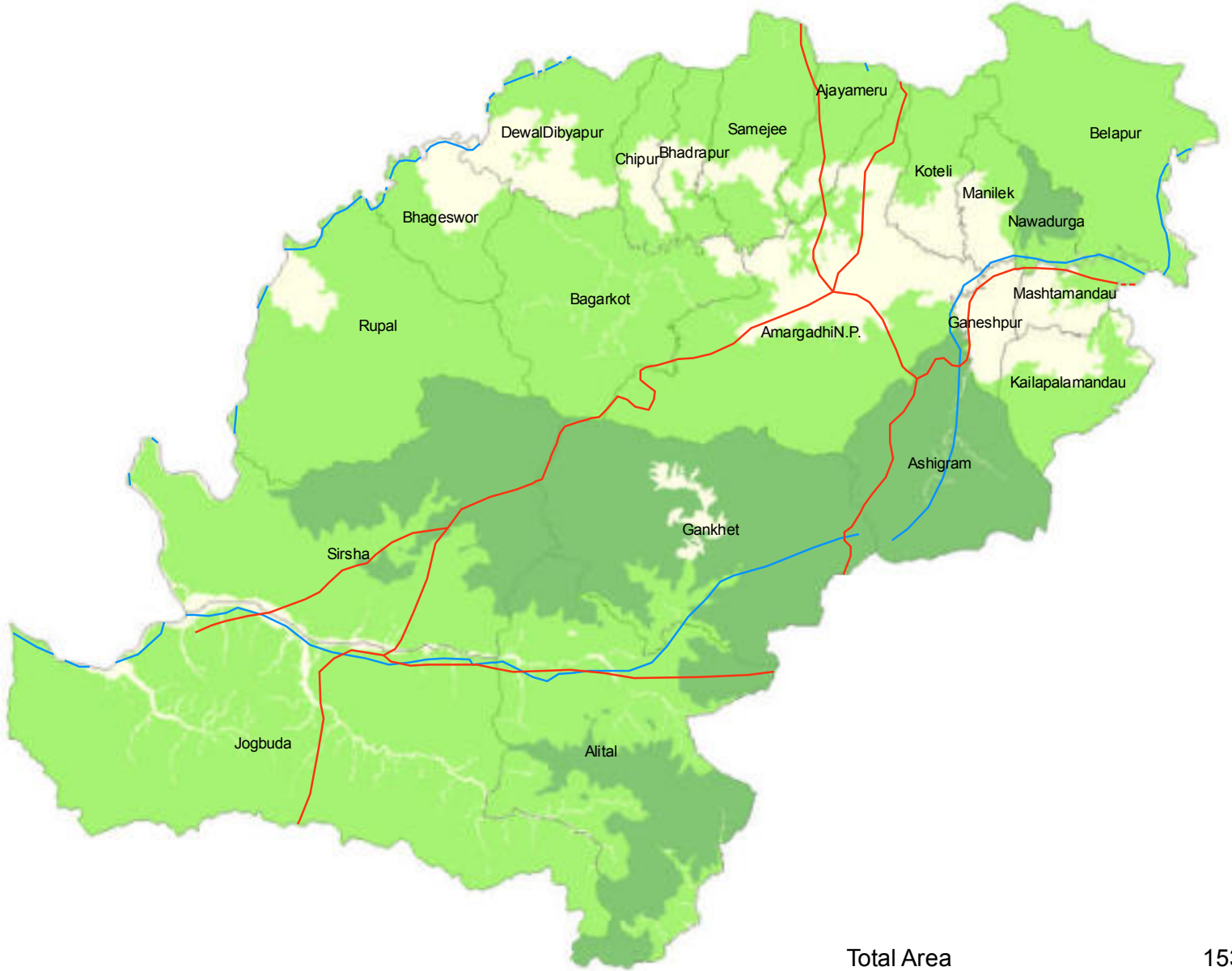
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Baitadi District

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Total Area	1599 sq.km.
Forest Area	827 sq.km.
Chiuri Potential Forest Area	282 sq.km.
Estimated Chiuri Area	93 sq.km.
Estimated no. of Chiuri trees	520614

Dadeldhura



Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Dadeldhura District

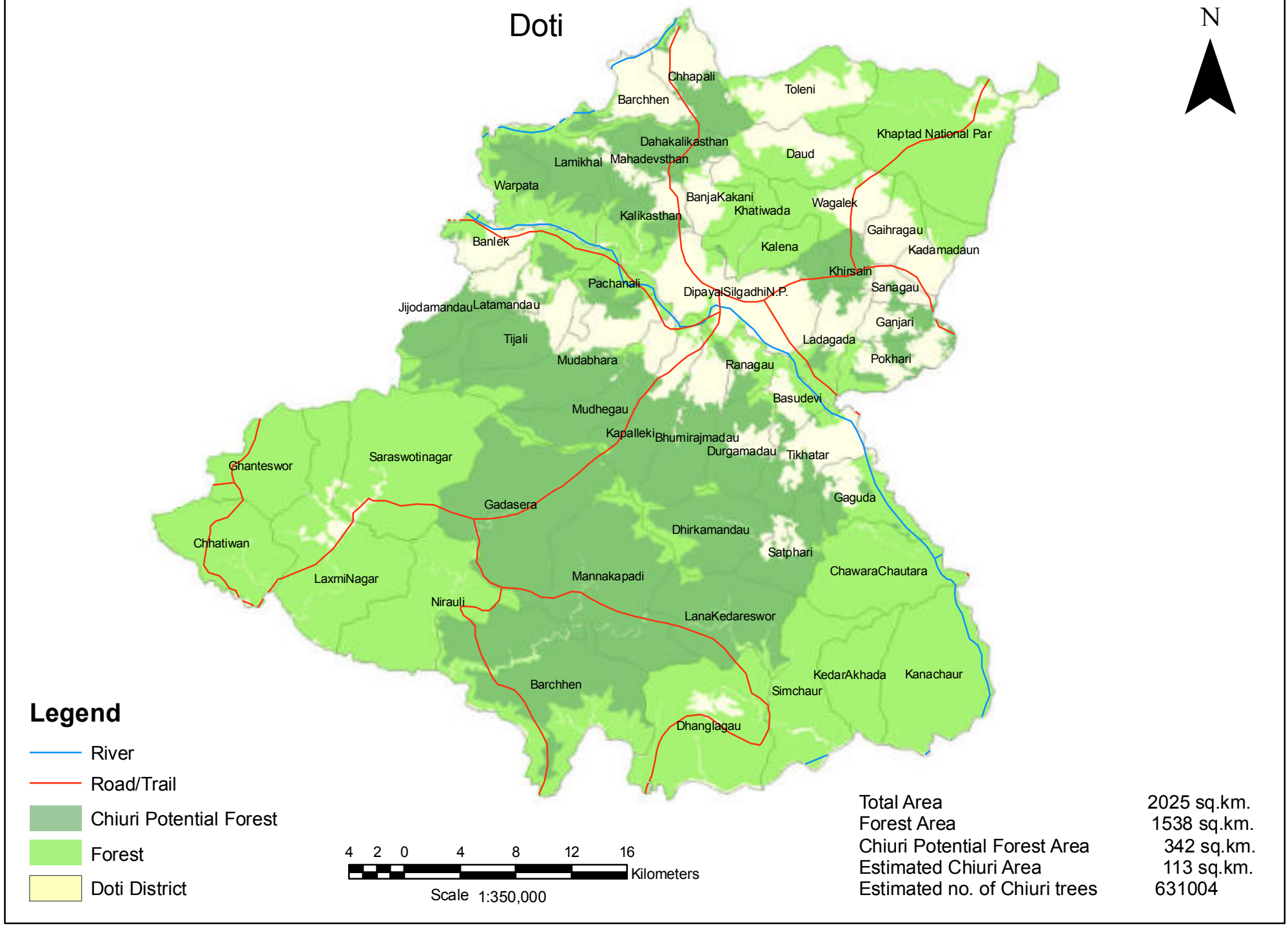
Total Area	1538 sq.km.
Forest Area	1213 sq.km.
Chiuri Potential Forest Area	246 sq.km.
Estimated Chiuri Area	81 sq.km.
Estimated no. of Chiuri trees	4453929

Darchula

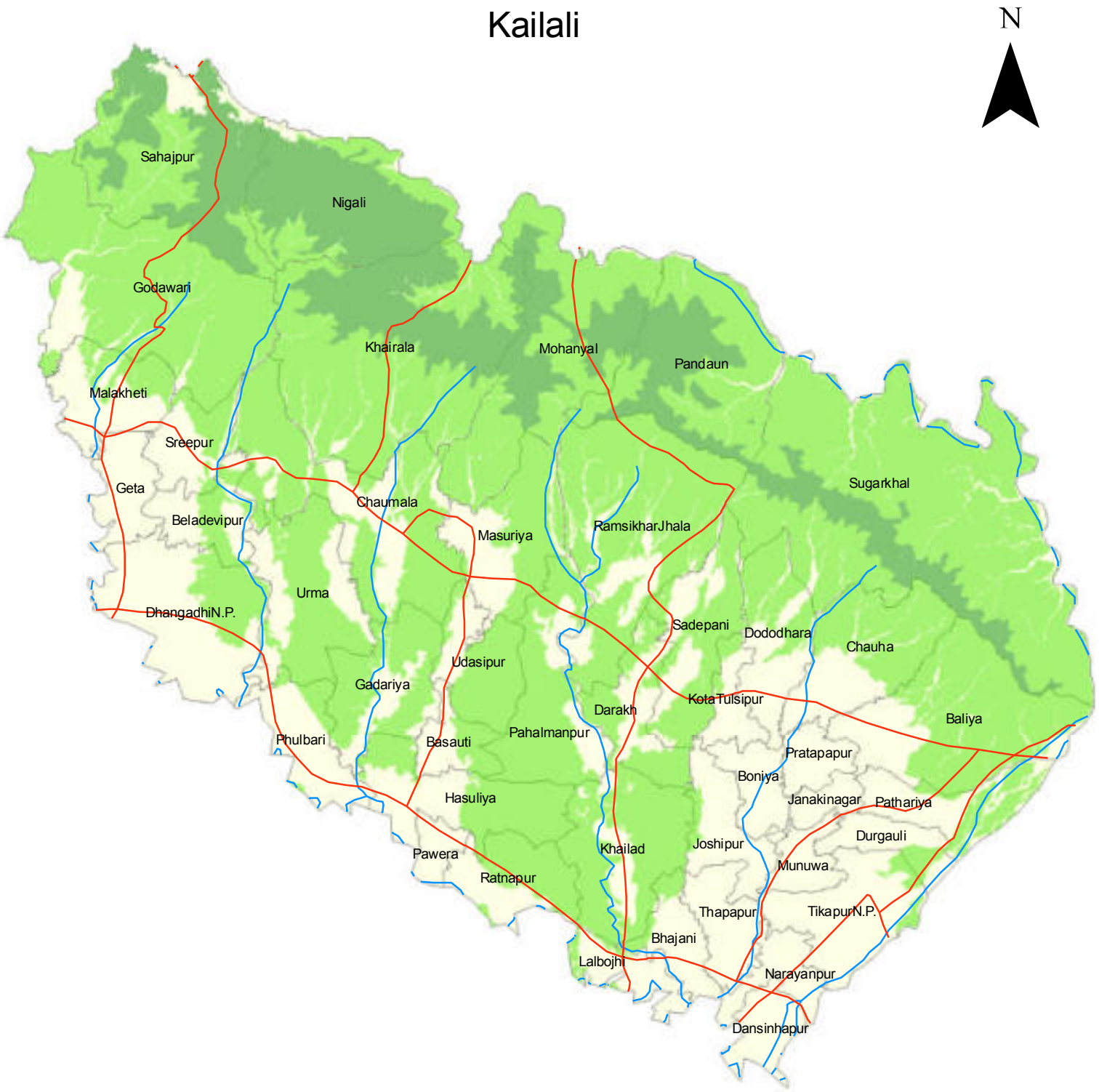
Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Darchula District

Total Area	2322 sq.km.
Forest Area	1010 sq.km.
Chiuri Potential Forest Area	104 sq.km.
Estimated Chiuri Area	34 sq.km.
Estimated no. of Chiuri trees	192063


Doti
N
Chhapali
Toleni
Barchhen
Khaptad National Par
Dahakalikasthan
Daud
Lamikhal
Mahadevsthan
Warpata
BanjaKakani
Khatiwada
Wagalek
Kalikasthan
Gaihragau
Banlek
Kalena
Kadamadaun
Khirsain
Pachanali
Sanagau
DipayalSilgadhiN.P.
Jijodamandau
Latamandau
Ganjari
Tijali
Ladagada
Mudabhara
Pokhari
Ranagau
Basudevi
Mudhegau
Kapalleki
Bhumirajmadau
Durgamadau
Tikhatar
Saraswotinagar
Ghanteswor
Gaguda
Gadasera
Dhirkamandau
Chhatiwan
Satphari
ChawaraChautara
LaxmiNagar
Mannakapadi
Nirauli
LanaKedareswor
KedarAkhada
Kanachaur
Barchhen
Simchaur
Dhanglagau
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Doti District
4 2 0 4 8 12 16
Kilometers
Scale 1:350,000
Total Area 2025 sq.km.
Forest Area 1538 sq.km.
Chiuri Potential Forest Area 342 sq.km.
Estimated Chiuri Area 113 sq.km.
Estimated no. of Chiuri trees 631004

Kailali



Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Kailali District

Total Area	3235 sq.km.
Forest Area	2038 sq.km.
Chiuri Potential Forest Area	166 sq.km.
Estimated Chiuri Area	55 sq.km.
Estimated no. of Chiuri trees	306588

4 2 0 4 8 12 16 Kilometers

Scale 1:400,000

MID WESTERN DEVELOPMENT REGION

Dailekh

Total Area	1502 sq.km.
Forest Area	1364 sq.km.
Chiuri Potential Forest Area	121 sq.km.
Estimated Chiuri Area	40 sq.km.
Estimated no. of Chiuri trees	222479

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Dailekh District

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Dang

N

Legend

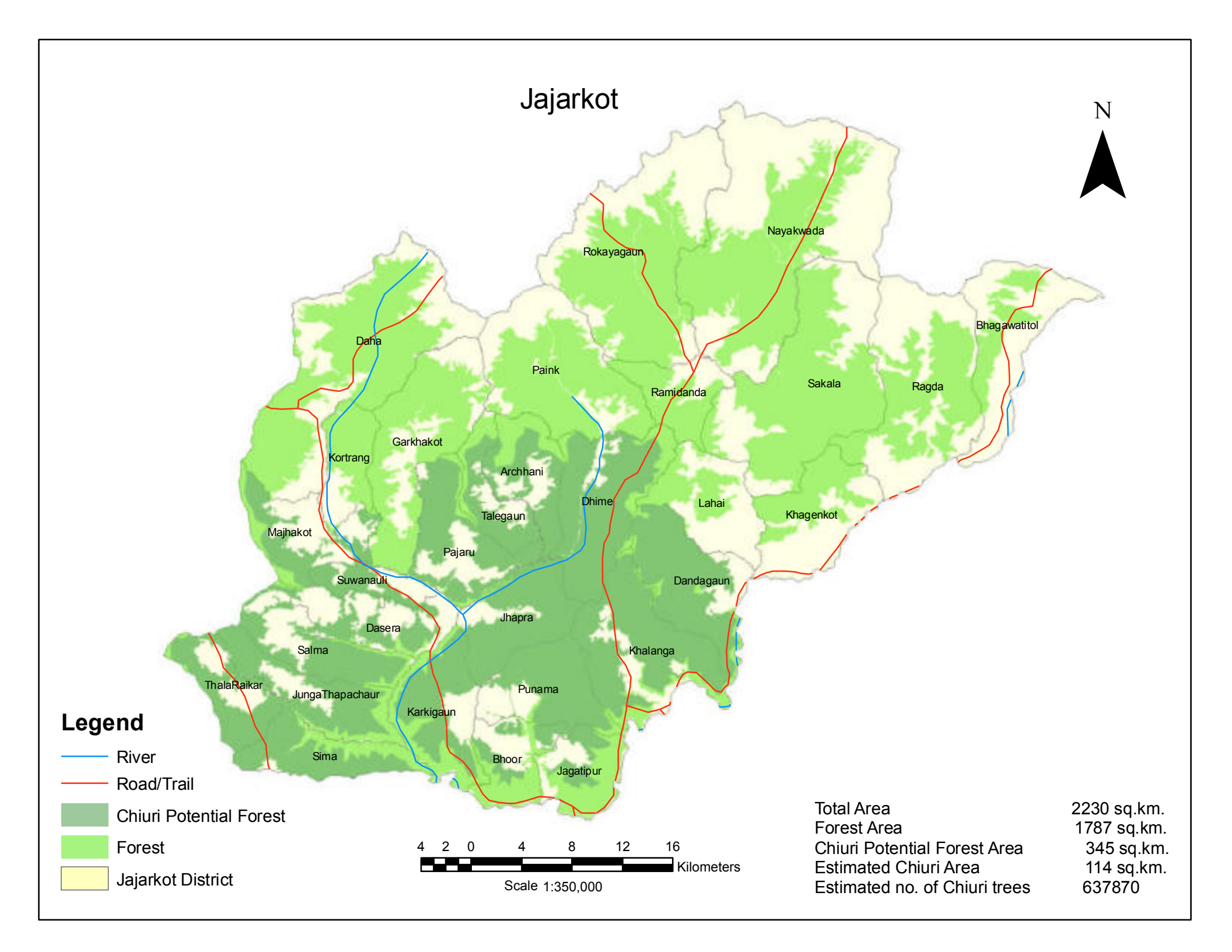
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Dang District

4 2 0 4 8 12 16 Kilometers

Scale 1:400,000

Total Area	2955 sq.km.
Forest Area	873 sq.km.
Chiuri Potential Forest Area	281 sq.km.
Estimated Chiuri Area	93 sq.km.
Estimated no. of Chiuri trees	519211

Jajarkot



Total Area	2230 sq.km.
Forest Area	1787 sq.km.
Chiuri Potential Forest Area	345 sq.km.
Estimated Chiuri Area	114 sq.km.
Estimated no. of Chiuri trees	637870

Pyuthan

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Pyuthan District

Total Area	1309 sq.km.
Forest Area	935 sq.km.
Chiuri Potential Forest Area	288 sq.km.
Estimated Chiuri Area	95 sq.km.
Estimated no. of Chiuri trees	530820

0 2 4 8 12 16 Kilometers

Scale 1:300,000


Rolpa
N
Pachhawang
Rangkot
Rank
Eriwang
Thawang
Pakhapani
Kureli
Bhirul
Rangsi
Uwa
Talawang
Seram
Jinawang
Jankot
Wot
Whama
Jailwang
Dhawang
Gaam
Ghartigaun
Bhawang
Korchawang
Jungar
Fagaam
Jaimakasala
Siuri
Kotgaun
Gajul
Gairigaun
Harjang
Budagaun
Liwang
Gumchal
Pang
Kareti
Khumel
Wadachaur
Nuwagaun
Jedwang
Mijhing
Sakhi
Khungri
Tewang
Sirpa
Jhenam
Ghodagaun
Aresh
JauliPokhari
Dubaring
Dubidanda
Masina
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Rolpa District
0 2 4 8 12 16
Kilometers
Scale 1:300,000
Total Area 1879 sq.km.
Forest Area 1375 sq.km.
Chiuri Potential Forest Area 324 sq.km.
Estimated Chiuri Area 107 sq.km.
Estimated no. of Chiuri trees 598834

Rukum

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Rukum District

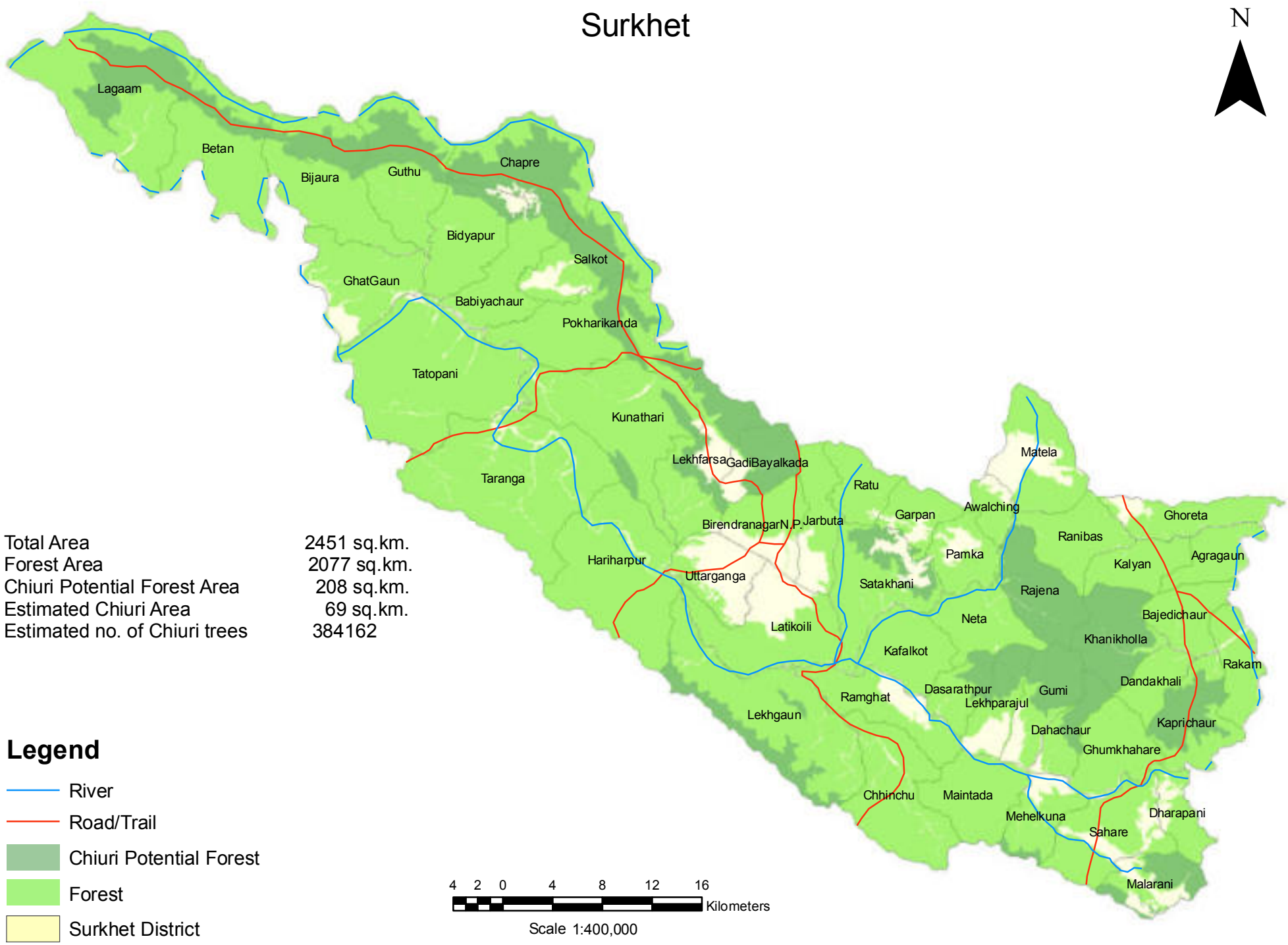
6 3 0 6 12 18 24 Kilometers

Scale 1:400,000

Total Area	2877 sq.km.
Forest Area	1607 sq.km.
Chiuri Potential Forest Area	291 sq.km.
Estimated Chiuri Area	96 sq.km.
Estimated no. of Chiuri trees	537299

Salyan

Total Area	1462 sq.km.
Forest Area	922 sq.km.
Chiuri Potential Forest Area	239 sq.km.
Estimated Chiuri Area	79 sq.km.
Estimated no. of Chiuri trees	440954


Surkhet
N
Lagaam
Betan
Bijaura
Guthu
Chapre
Bidyapur
Salkot
GhatGaun
Babiyachaur
Pokharikanda
Tatopani
Kunathari
Lekhfarsa
GadiBayalkada
Taranga
Matela
Ratu
Awalching
Garpan
Ghoreta
BirendranagarN.P.
Jarbuta
Ranibas
Pamka
Agragaun
Kalyan
Hariharpur
Uttarganga
Satakhani
Rajena
Neta
Bajedichaur
Latikoili
Khanikholla
Kafalkot
Rakam
Dandakhali
Dasarathpur
Gumi
Ramghat
Lekhparajul
Lekhgaun
Dahachaur
Kaprichaur
Ghumkhahare
Chhinchu
Maintada
Mehelkuna
Dharapani
Sahare
Malarani
Total Area 2451 sq.km.
Forest Area 2077 sq.km.
Chiuri Potential Forest Area 208 sq.km.
Estimated Chiuri Area 69 sq.km.
Estimated no. of Chiuri trees 384162
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Surkhet District
4 2 0 4 8 12 16
Kilometers
Scale 1:400,000

WESTERN DEVELOPMENT REGION

Arghakhanchi

Legend

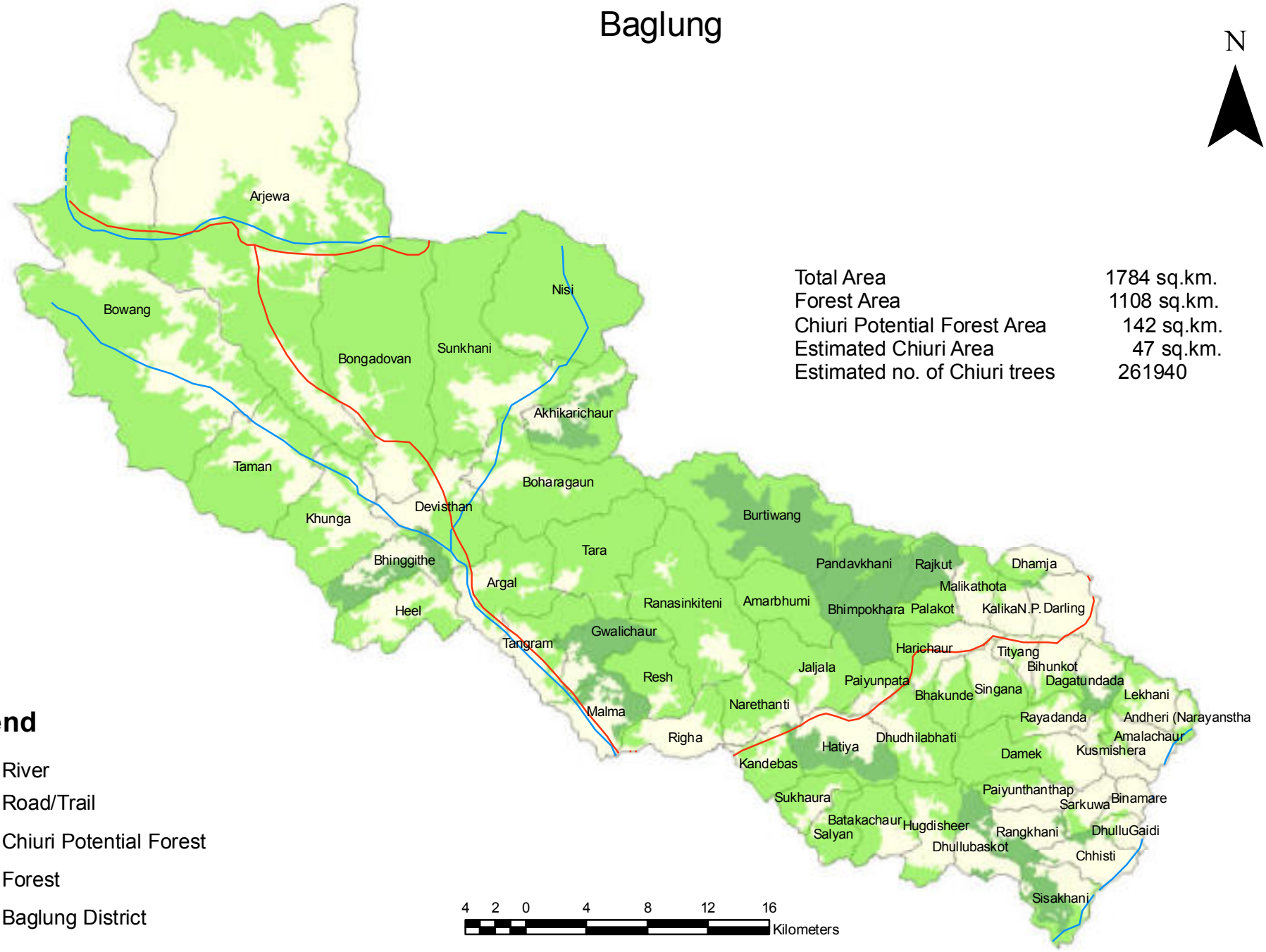
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Arghakhanchi District

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Total Area	1193 sq.km.
Forest Area	919 sq.km.
Chiuri Potential Forest Area	187 sq.km.
Estimated Chiuri Area	62 sq.km.
Estimated no. of Chiuri trees	345679

Baglung

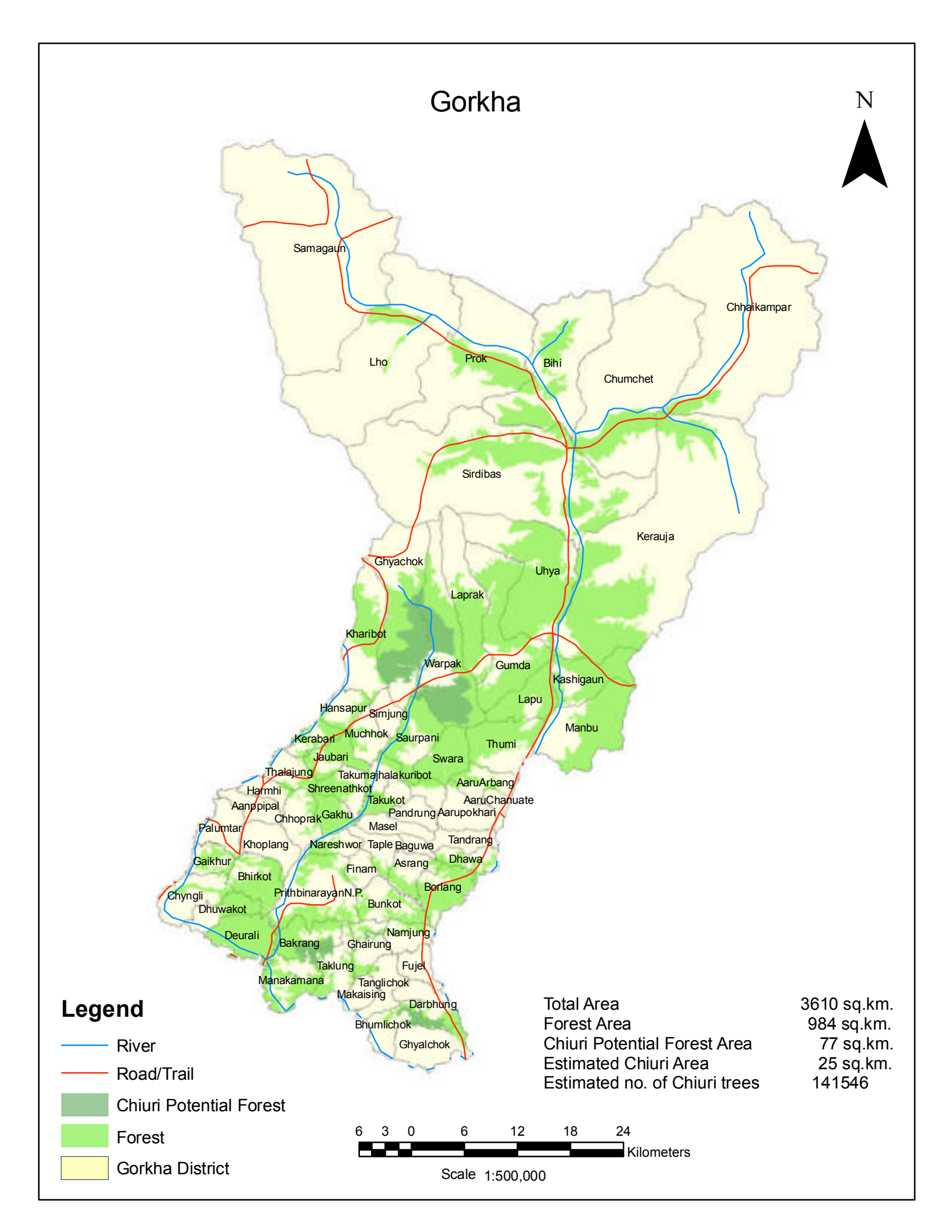


Total Area	1784 sq.km.
Forest Area	1108 sq.km.
Chiuri Potential Forest Area	142 sq.km.
Estimated Chiuri Area	47 sq.km.
Estimated no. of Chiuri trees	261940

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Baglung District

Gorkha


N
Samagaun
Lho
Prok
Bihi
Chhaikampar
Chumchet
Sirdibas
Kerauja
Ghyachok
Uhya
Laprak
Kharibot
Warpak
Gumda
Kashigaun
Lapu
Manbu
Hansapur
Simjung
Kerabari
Muchhok
Saurpani
Thumi
Jaubari
Swara
Thalajung
Takumajhalakuribot
AaruArbang
Harmhi
Shreenathkot
Takukot
AaruChanuate
Aanppipal
Chhoprak
Gakhu
Pandrung
Aarupokhari
Palumtar
Masel
Khoplang
Nareshwor
Taple
Baguwa
Tandrang
Gaikhur
Asrang
Dhawa
Finam
Bhirkot
Borlang
Chyngli
PrithbinarayanN.P.
Dhuwakot
Bunkot
Deurali
Namjung
Bakrang
Ghairung
Taklung
Fujel
Manakamana
Tanglichok
Makaising
Darbhung
Bhumlichok
Ghyalchok
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Gorkha District
Total Area 3610 sq.km.
Forest Area 984 sq.km.
Chiuri Potential Forest Area 77 sq.km.
Estimated Chiuri Area 25 sq.km.
Estimated no. of Chiuri trees 141546
6 3 0 6 12 18 24
Kilometers
Scale 1:500,000

Gulmi

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Gulmi District

4 2 0 4 8 12 16 Kilometers

Scale 1:250,000

Total Area	1149 sq.km.
Forest Area	502 sq.km.
Chiuri Potential Forest Area	36 sq.km.
Estimated Chiuri Area	12 sq.km.
Estimated no. of Chiuri trees	66906

Kaski

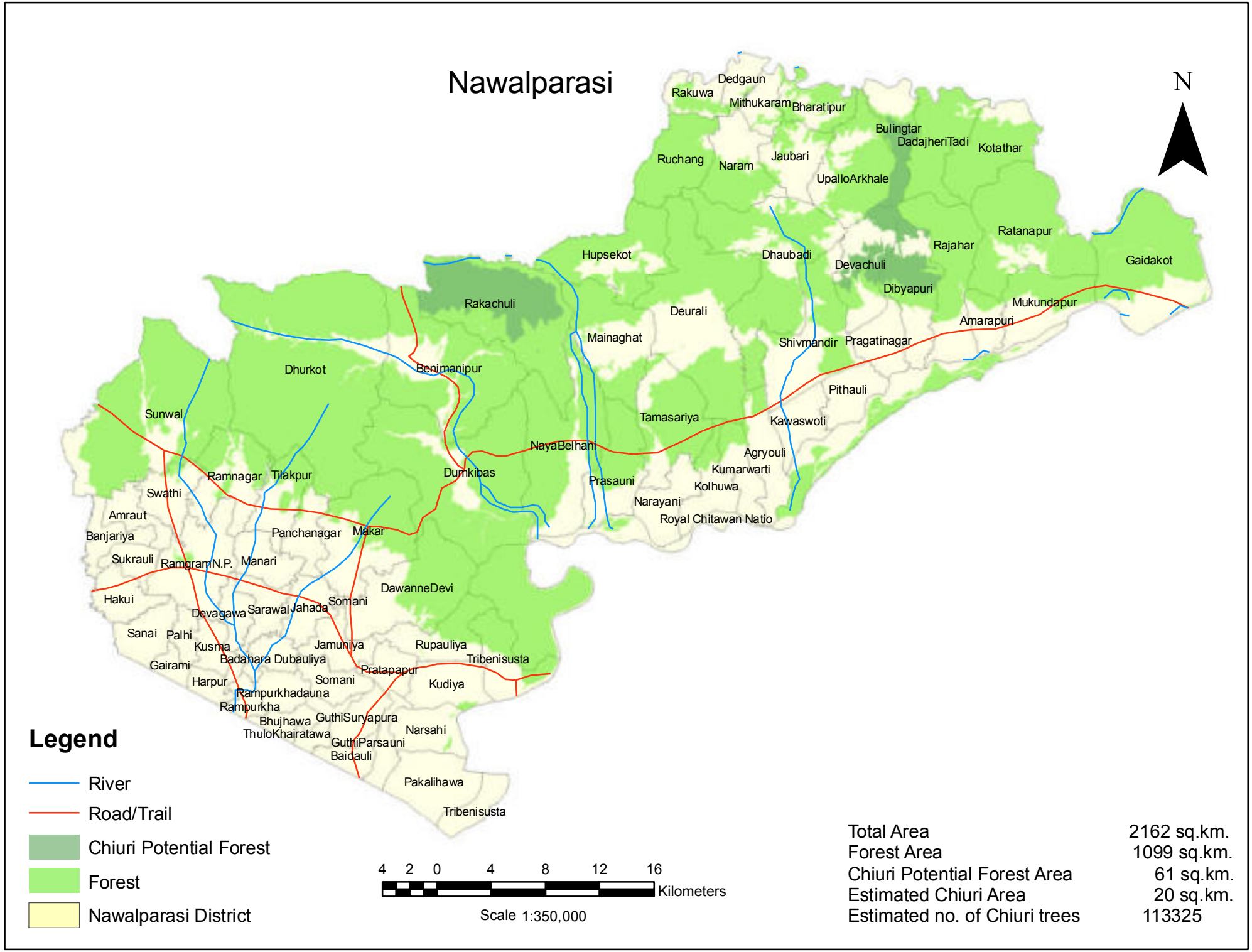
Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Kaski District

Total Area	2017 sq.km.
Forest Area	969 sq.km.
Chiuri Potential Forest Area	57 sq.km.
Estimated Chiuri Area	19 sq.km.
Estimated no. of Chiuri trees	105703

4 2 0 4 8 12 16 Kilometers

Scale 1:350,000


Nawalparasi
N
Dedgaun
Rakuwa
Mithukaram
Bharatipur
Bulingtar
DadajheriTadi
Kotathar
Ruchang
Naram
Jaubari
UpalloArkhale
Ratanapur
Rajahar
Hupsekot
Dhaubadi
Devachuli
Gaidakot
Dibyapuri
Rakachuli
Deurali
Mukundapur
Amarapuri
Mainaghat
Shivmandir
Pragatinagar
Dhurkot
Benimanipur
Pithauli
Sunwal
Tamasariya
Kawaswoti
NayaBelhani
Agryouli
Ramnagar
Tilakpur
Dumkibas
Kumarwarti
Prasauni
Kolhuwa
Swathi
Narayani
Amraut
Royal Chitawan Natio
Banjariya
Panchanagar
Makar
Sukrauli
RamgramN.P.
Manari
DawanneDevi
Hakui
Somani
Devagawa
Sarawal
Jahada
Sanai
Palhi
Kusma
Jamuniya
Rupauliya
Badahara Dubauliya
Tribenisusta
Gairami
Pratapapur
Harpur
Somani
Kudiya
Rampurkhadauna
Rampurkha
Bhujhawa
GuthiSuryapura
ThuloKhairatawa
Narsahi
GuthiParsauni
Baidauli
Pakalihawa
Tribenisusta
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Nawalparasi District
4 2 0 4 8 12 16
Kilometers
Scale 1:350,000
Total Area 2162 sq.km.
Forest Area 1099 sq.km.
Chiuri Potential Forest Area 61 sq.km.
Estimated Chiuri Area 20 sq.km.
Estimated no. of Chiuri trees 113325

Palpa

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Palpa District

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Total Area	1373 sq.km.
Forest Area	935 sq.km.
Chiuri Potential Forest Area	108 sq.km.
Estimated Chiuri Area	36 sq.km.
Estimated no. of Chiuri trees	198781

Parbat

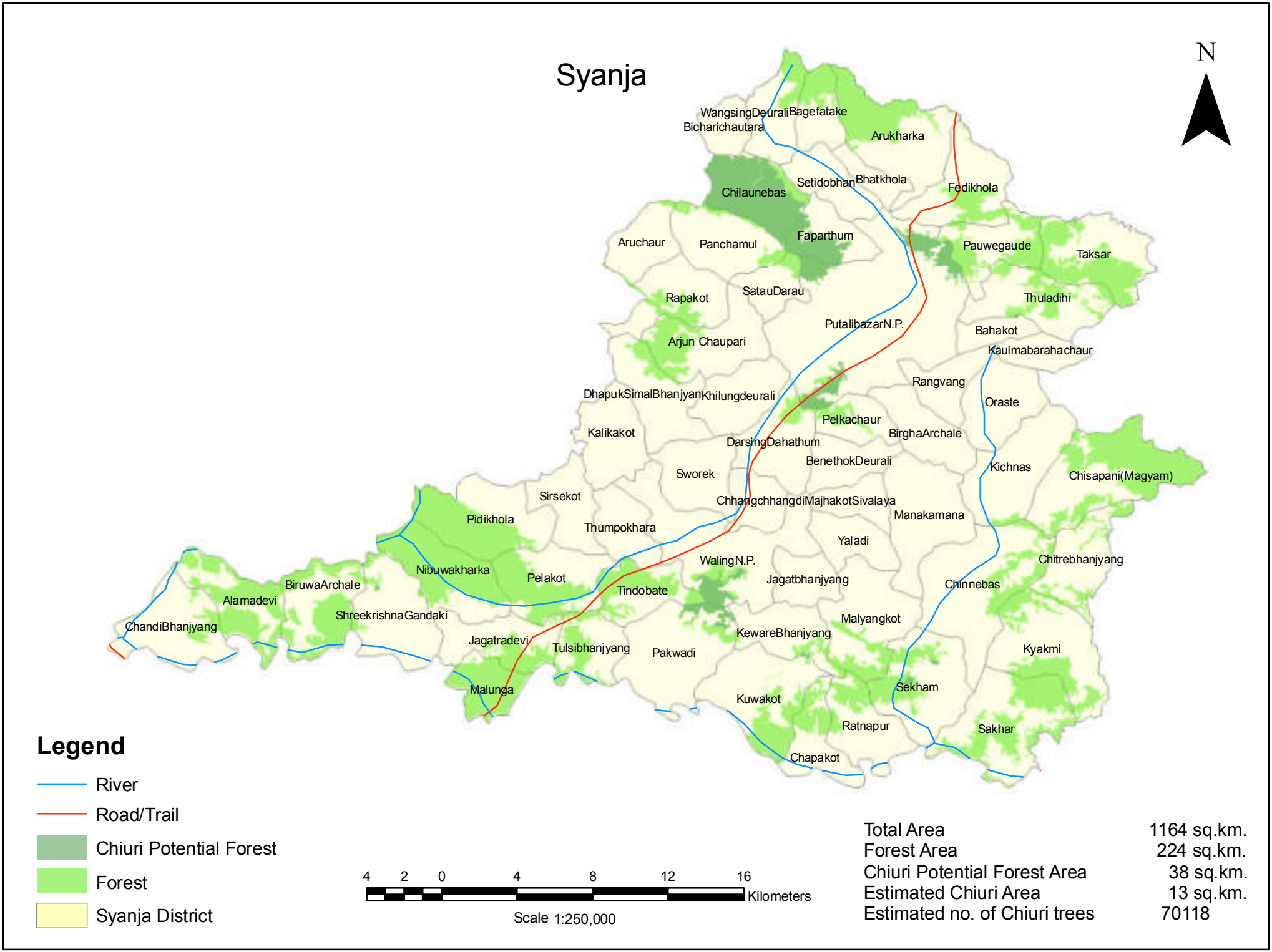
Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Parbat District

Total Area	494 sq.km.
Forest Area	213 sq.km.
Chiuri Potential Forest Area	39 sq.km.
Estimated Chiuri Area	13 sq.km.
Estimated no. of Chiuri trees	71779

4 2 0 4 8 12 16 Kilometers

Scale 1:250,000


Syanja
N
WangsingDeurali
Bagefatake
Bicharichautara
Arukharka
Chilaunebas
Setidobhan
Bhatkhola
Fedikhola
Faparthum
Aruchaur
Panchamul
Pauwegaude
Taksar
Rapakot
SatauDarau
Thuladihi
PutalibazarN.P.
Bahakot
Arjun Chaupari
Kaulmabarahachaur
Rangvang
DhapukSimalBhanjyang
Khilungdeurali
Oraste
Pelkachaur
Kalikakot
BirghaArchale
DarsingDahathum
BenethokDeurali
Kichnas
Sworek
Chisapani(Magyam)
Sirsekot
ChhangchhangdiMajhakotSivalaya
Pidikhola
Manakamana
Thumpokhara
Yaladi
WalingN.P.
Chitrebhanjyang
Nibuwakharka
Pelakot
Jagatbhanjyang
BiruwaArchale
Tindobate
Chinnebas
Alamadevi
ShreekrishnaGandaki
Malyangkot
ChandiBhanjyang
KewareBhanjyang
Jagatradevi
Tulsibhanjyang
Pakwadi
Kyakmi
Malunga
Sekham
Kuwakot
Ratnapur
Sakhar
Chapakot
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Syanja District
4 2 0 4 8 12 16
Kilometers
Scale 1:250,000
Total Area 1164 sq.km.
Forest Area 224 sq.km.
Chiuri Potential Forest Area 38 sq.km.
Estimated Chiuri Area 13 sq.km.
Estimated no. of Chiuri trees 70118

Tanahu

Legend

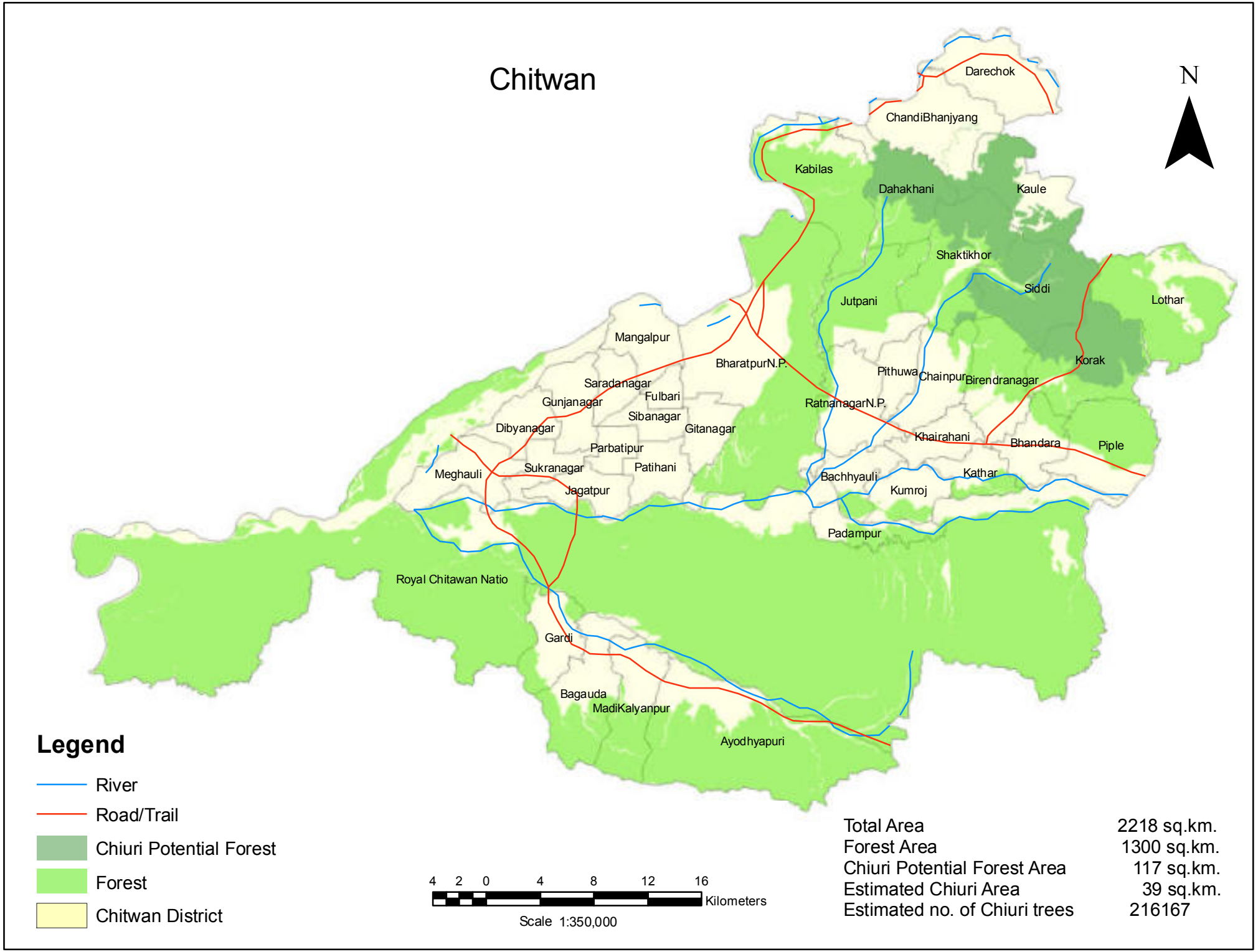
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Tanahu District

4 2 0 4 8 12 16 Kilometers

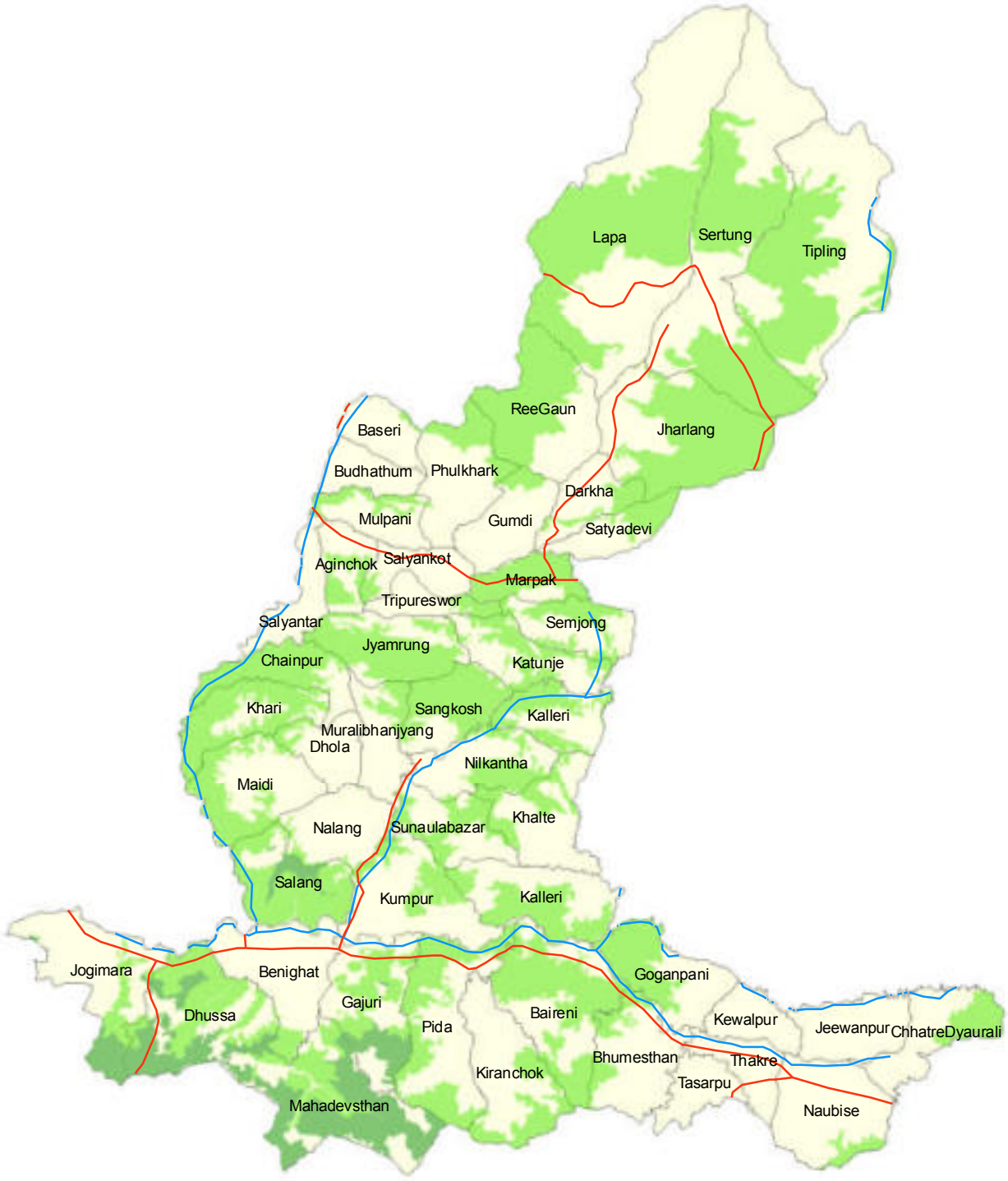
Scale 1:300,000

Total Area	1546 sq.km.
Forest Area	777 sq.km.
Chiuri Potential Forest Area	43 sq.km.
Estimated Chiuri Area	14 sq.km.
Estimated no. of Chiuri trees	79346

CENTRAL DEVELOPMENT REGION


Chitwan
N
Darechok
ChandiBhanjyang
Kabilas
Dahakhani
Kaule
Shaktikhor
Siddi
Lothar
Jutpani
Mangalpur
BharatpurN.P.
Korak
Pithuwa
Chainpur
Birendranagar
Saradanagar
Gunjanagar
Fulbari
RatnanagarN.P.
Sibanagar
Dibyanagar
Gitanagar
Khairahani
Bhandara
Piple
Parbatipur
Meghauli
Sukranagar
Patihani
Bachhyauli
Kathar
Jagatpur
Kumroj
Padampur
Royal Chitawan Natio
Gardi
Bagauda
MadiKalyanpur
Ayodhyapuri
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Chitwan District
4 2 0 4 8 12 16
Kilometers
Scale 1:350,000
Total Area 2218 sq.km.
Forest Area 1300 sq.km.
Chiuri Potential Forest Area 117 sq.km.
Estimated Chiuri Area 39 sq.km.
Estimated no. of Chiuri trees 216167

Dhading



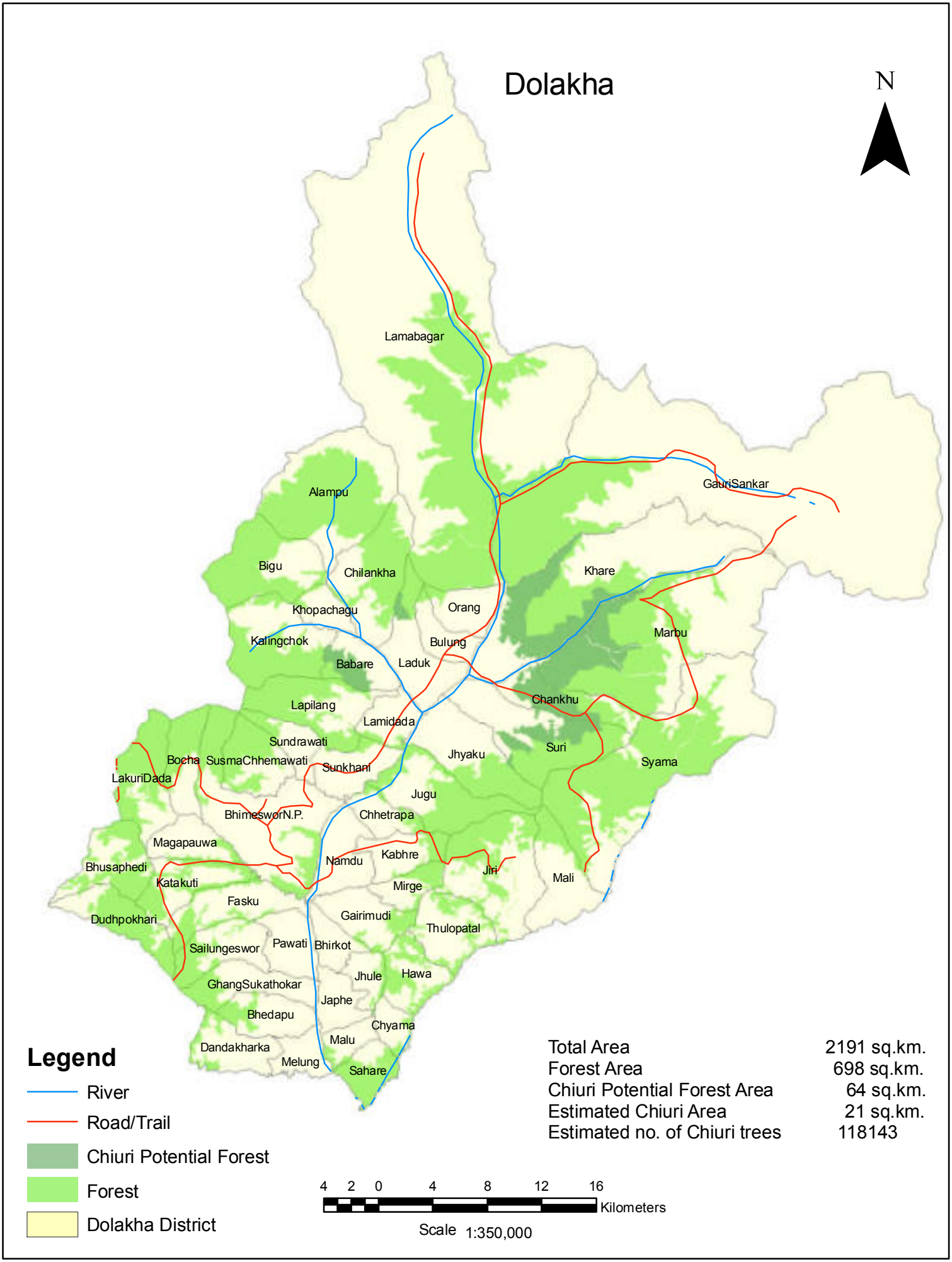
Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Dhading District

Total Area	1926 sq.km.
Forest Area	721 sq.km.
Chiuri Potential Forest Area	64 sq.km.
Estimated Chiuri Area	21 sq.km.
Estimated no. of Chiuri trees	118124

4 2 0 4 8 12 16 Kilometers

Scale 1:400,000


Dolakha
N
Lamabagar
Alampu
GauriSankar
Bigu
Chilankha
Khare
Khopachagu
Orang
Kalingchok
Bulung
Marbu
Babare
Laduk
Chankhu
Lapilang
Lamidada
Sundrawati
Suri
Jhyaku
Bocha
SusmaChhemawati
Sunkhani
Syama
LakuriDada
Jugu
BhimesworN.P.
Chhetrapa
Magapauwa
Namdu
Kabhre
Bhusaphedi
Jiri
Mali
Katakuti
Mirge
Fasku
Gairimudi
Dudhpokhari
Thulopatal
Sailungeswor
Pawati
Bhirkot
Jhule
Hawa
GhangSukathokar
Japhe
Bhedapu
Chyama
Malu
Dandakharka
Melung
Sahare
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Dolakha District
Total Area 2191 sq.km.
Forest Area 698 sq.km.
Chiuri Potential Forest Area 64 sq.km.
Estimated Chiuri Area 21 sq.km.
Estimated no. of Chiuri trees 118143
4 2 0 4 8 12 16
Kilometers
Scale 1:350,000

Kavre

Legend

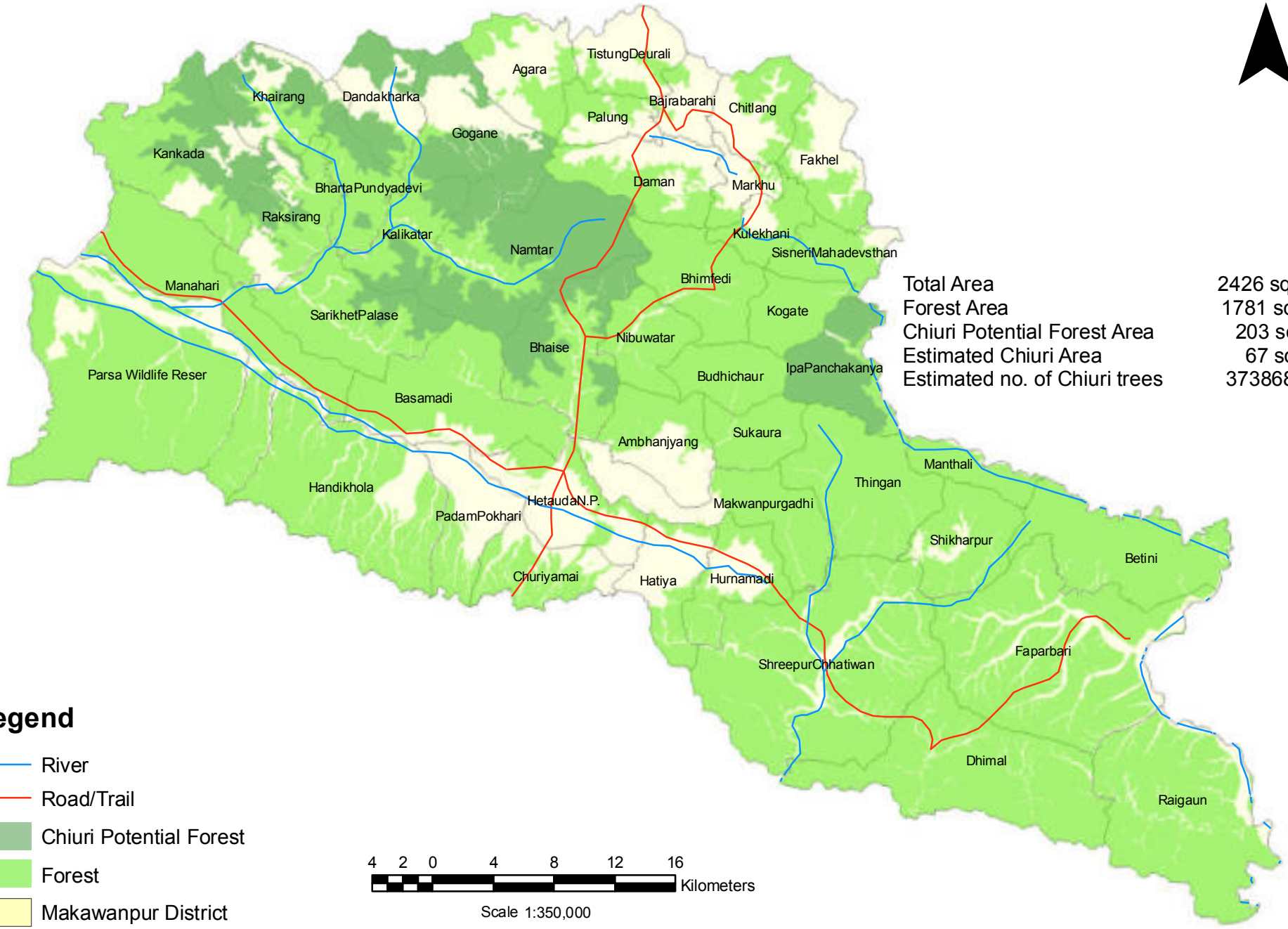
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Kavre District

Total Area	1396 sq.km.
Forest Area	497 sq.km.
Chiuri Potential Forest Area	35 sq.km.
Estimated Chiuri Area	11 sq.km.
Estimated no. of Chiuri trees	63713

4 2 0 4 8 12 16 Kilometers

Scale 1:250,000

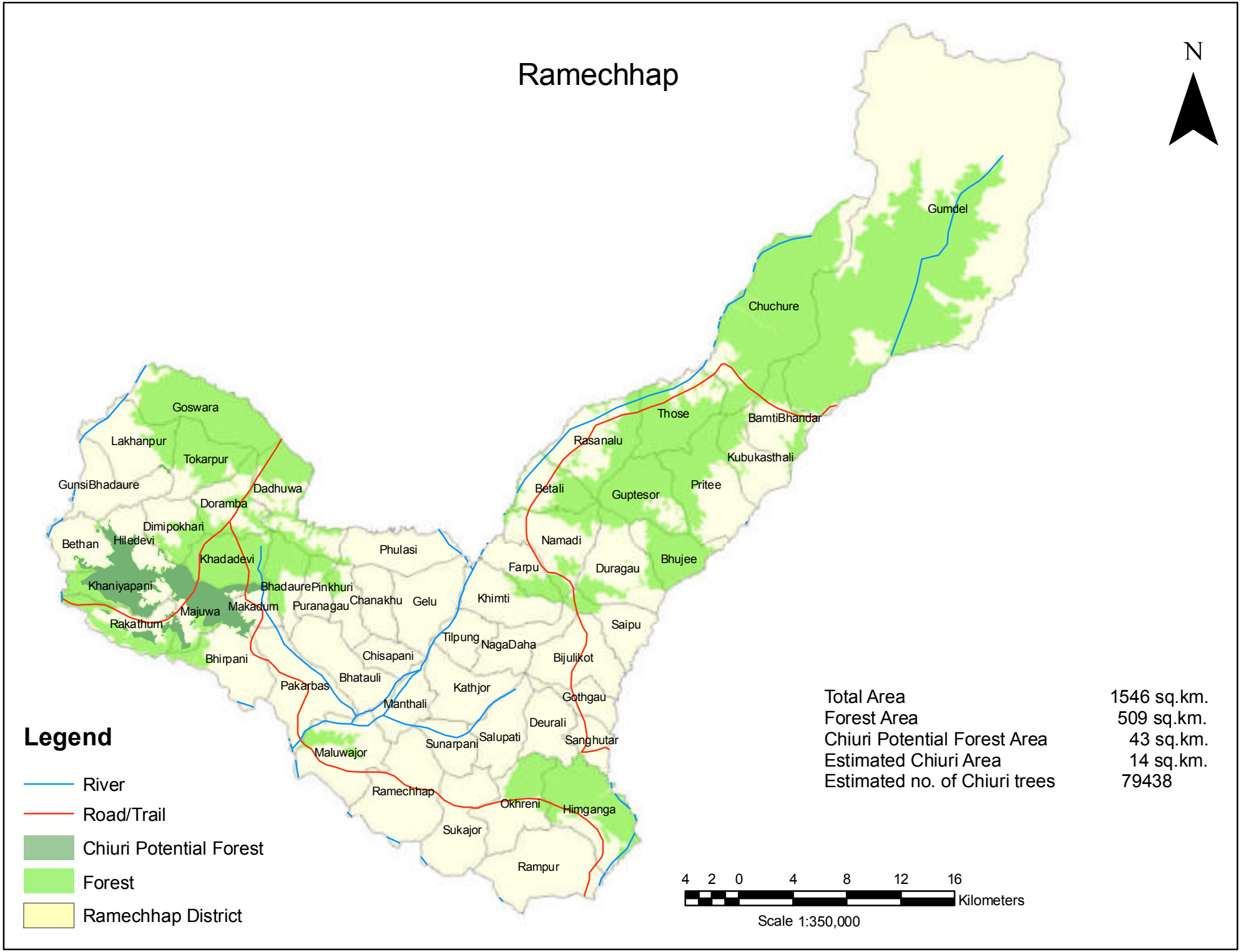
Makawanpur


N
TistungDeurali
Agara
Khairang
Dandakharka
Bajrabarahi
Chitlang
Palung
Gogane
Kankada
Fakhel
Daman
Markhu
BhartaPundyadevi
Raksirang
Kalikatar
Namtar
Kulekhani
SisneriMahadevsthan
Bhimfedi
Manahari
Kogate
SarikhetPalase
Nibuwatar
Bhaise
IpaPanchakanya
Parsa Wildlife Reser
Budhichaur
Basamadi
Sukaura
Ambhanjyang
Manthali
Thingan
Handikhola
HetaudaN.P.
Makwanpurgadhi
PadamPokhari
Shikharpur
Betini
Churiyamai
Hatiya
Hurnamadi
Faparbari
ShreepurChhatiwan
Dhimal
Raigaun
Total Area 2426 sq.km.
Forest Area 1781 sq.km.
Chiuri Potential Forest Area 203 sq.km.
Estimated Chiuri Area 67 sq.km.
Estimated no. of Chiuri trees 373868
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Makawanpur District
4 2 0 4 8 12 16
Kilometers
Scale 1:350,000

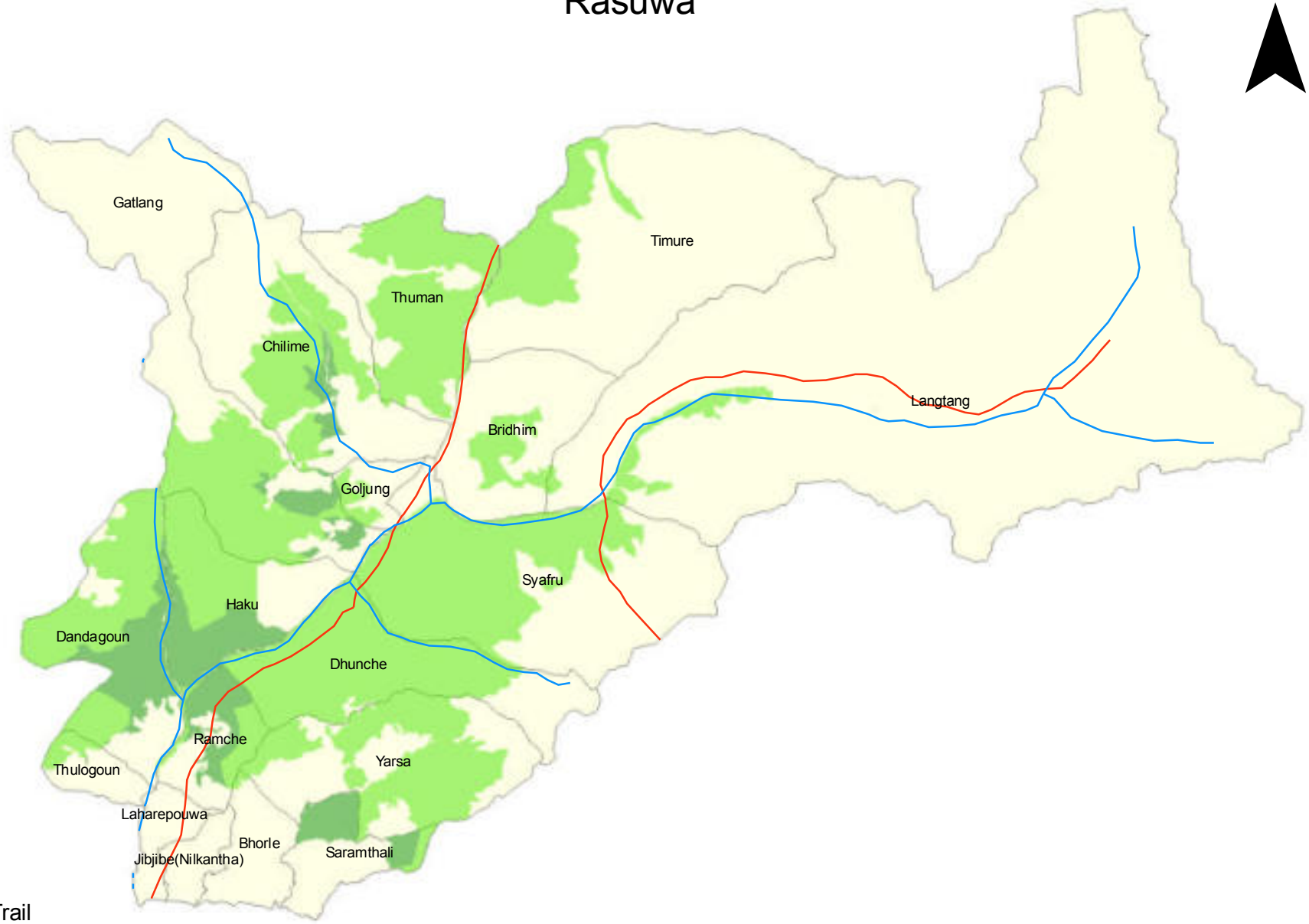
Nuwakot

Total Area	1121 sq.km.
Forest Area	290 sq.km.
Chiuri Potential Forest Area	76 sq.km.
Estimated Chiuri Area	25 sq.km.
Estimated no. of Chiuri trees	140236

Ramechhap


N
Gumdel
Chuchure
Goswara
Lakhanpur
Tokarpur
GunsiBhadaure
Dadhuwa
Doramba
Dimipokhari
Bethan
Hiledevi
Khadadevi
Khaniyapani
Majuwa
Makadum
Rakathum
Bhirpani
BhadaurePinkhuri
Puranagau
Chanakhu
Gelu
Phulasi
Pakarbas
Bhatauli
Chisapani
Tilpung
NagaDaha
Khimti
Kathjor
Manthali
Maluwajor
Sunarpani
Salupati
Deurali
Gothgau
Sanghutar
Saipu
Bijulikot
Farpu
Duragau
Namadi
Bhujee
Betali
Guptesor
Pritee
Rasanalu
Those
BamtiBhandar
Kubukasthali
Ramechhap
Okhreni
Himganga
Sukajor
Rampur
Legend
River
Road/Trail
Chiuri Potential Forest
Forest
Ramechhap District
Total Area 1546 sq.km.
Forest Area 509 sq.km.
Chiuri Potential Forest Area 43 sq.km.
Estimated Chiuri Area 14 sq.km.
Estimated no. of Chiuri trees 79438
4 2 0 4 8 12 16
Kilometers
Scale 1:350,000

Rasuwa



Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Rasuwa District

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Total Area	1544 sq.km.
Forest Area	419 sq.km.
Chiuri Potential Forest Area	58 sq.km.
Estimated Chiuri Area	19 sq.km.
Estimated no. of Chiuri trees	107327

Sindhuli

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Sindhuli District

6 3 0 6 12 18 24 Kilometers

Scale 1:400,000

Total Area	2491 sq.km.
Forest Area	1936 sq.km.
Chiuri Potential Forest Area	108 sq.km.
Estimated Chiuri Area	36 sq.km.
Estimated no. of Chiuri trees	199039

EASTERN DEVELOPMENT REGION

Bhojpur

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Bhojpur District

Total Area	1507 sq.km.
Forest Area	680 sq.km.
Chiuri Potential Forest Area	44 sq.km.
Estimated Chiuri Area	15 sq.km.
Estimated no. of Chiuri trees	80841

4 2 0 4 8 12 16 Kilometers

Scale 1:350,000

Ilam

Legend

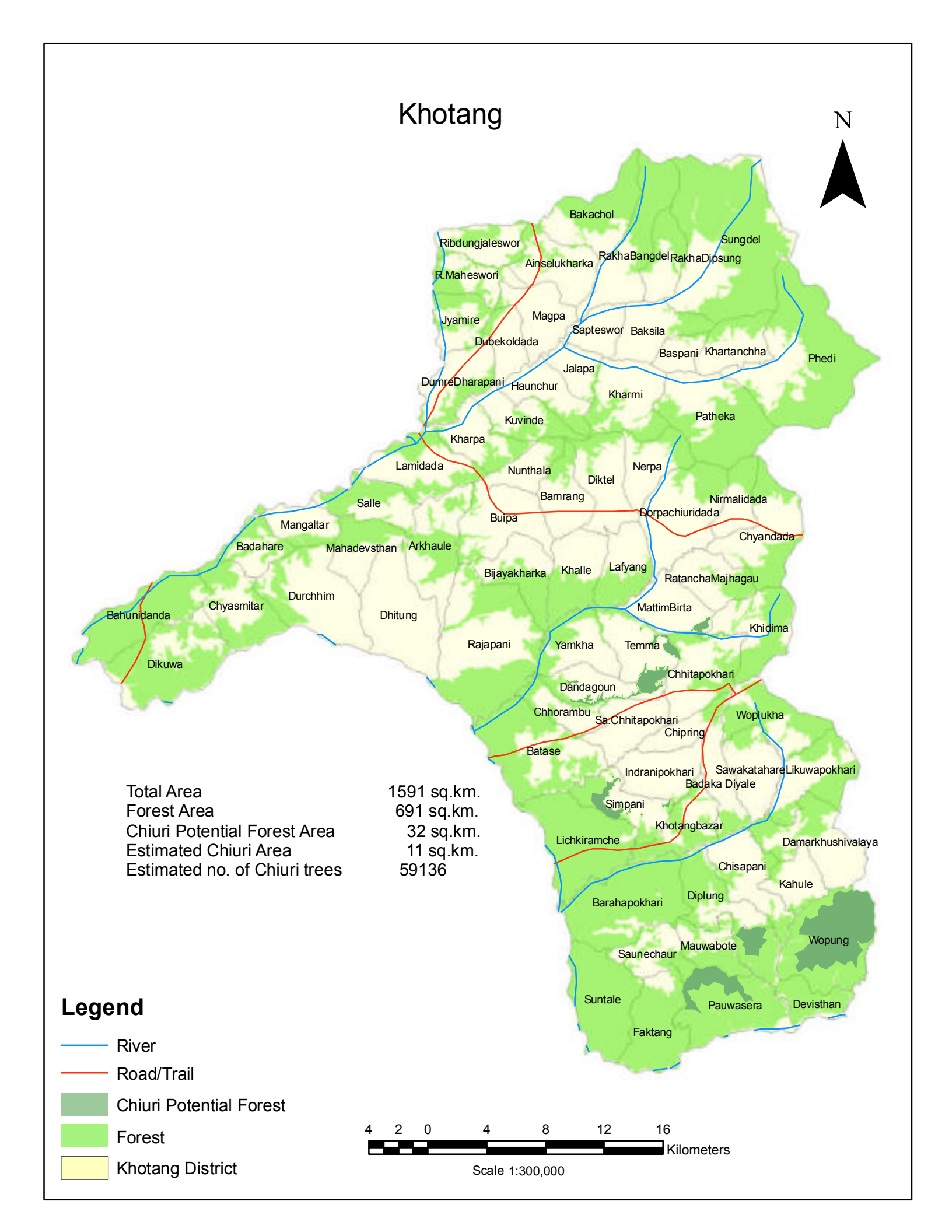
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Ilam District

Total Area	1703 sq.km.
Forest Area	1045 sq.km.
Chiuri Potential Forest Area	57 sq.km.
Estimated Chiuri Area	19 sq.km.
Estimated no. of Chiuri trees	104577

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Khotang



Total Area	1591 sq.km.
Forest Area	691 sq.km.
Chiuri Potential Forest Area	32 sq.km.
Estimated Chiuri Area	11 sq.km.
Estimated no. of Chiuri trees	59136

Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Khotang District

4 2 0 4 8 12 16 Kilometers

Scale 1:300,000

Okhaldhuga

N

Legend

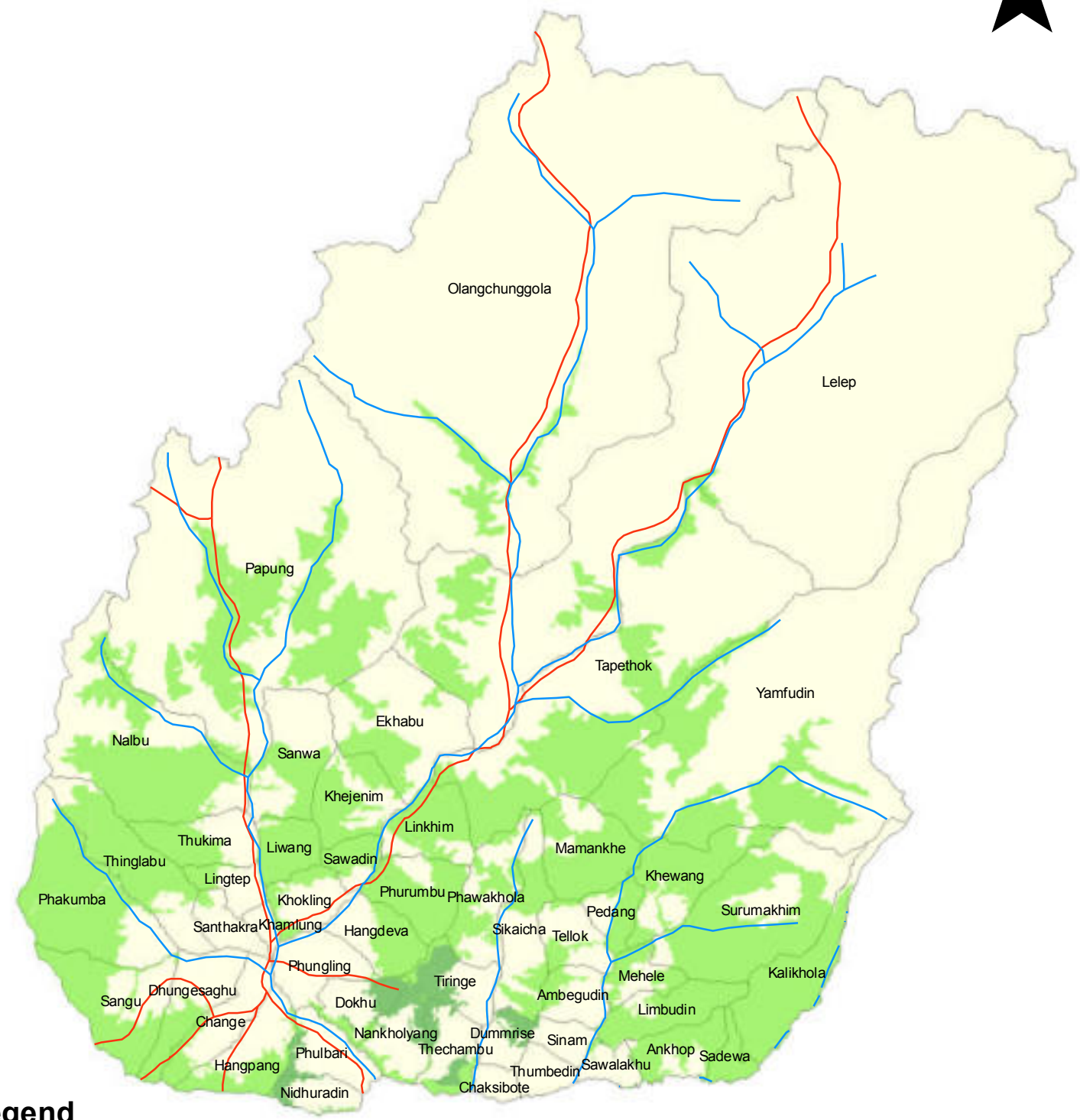
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Okhaldhunga District

4 2 0 4 8 12 16 Kilometers

Scale 1:250,000

Total Area	1074 sq.km.
Forest Area	405 sq.km.
Chiuri Potential Forest Area	54 sq.km.
Estimated Chiuri Area	18 sq.km.
Estimated no. of Chiuri trees	100129

Taplejung



Legend

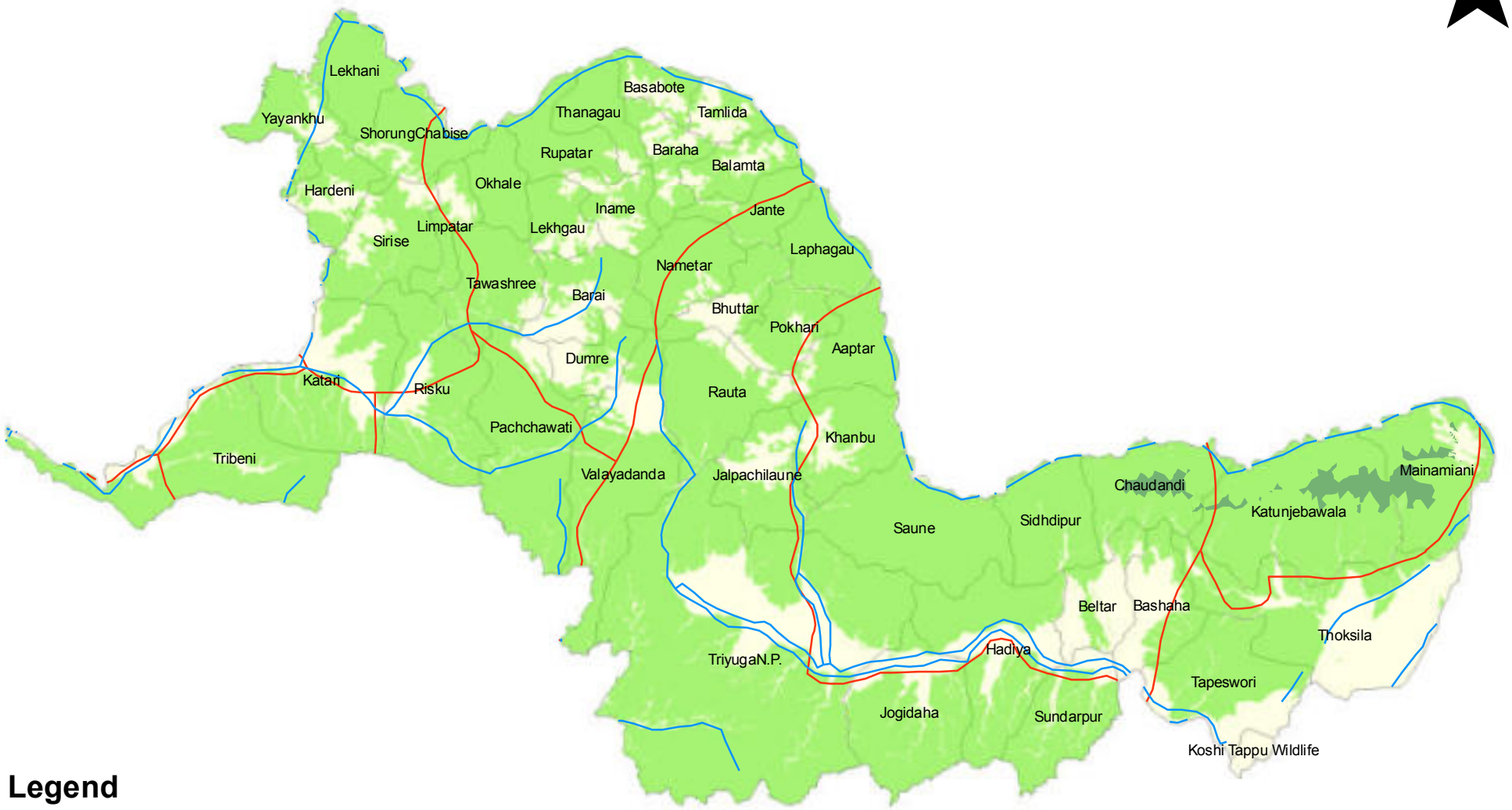
- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Taplejung District

Total Area	3646 sq.km.
Forest Area	891 sq.km.
Chiuri Potential Forest Area	37 sq.km.
Estimated Chiuri Area	12 sq.km.
Estimated no. of Chiuri trees	68900

4 2 0 4 8 12 16 Kilometers

Scale 1:400,000

Udayapur



Legend

- River
- Road/Trail
- Chiuri Potential Forest
- Forest
- Udayapur District

4 2 0 4 8 12 16 Kilometers

Scale 1:400,000

Total Area	2063 sq.km.
Forest Area	1664 sq.km.
Chiuri Potential Forest Area	27 sq.km.
Estimated Chiuri Area	9 sq.km.
Estimated no. of Chiuri trees	50184